The FOUNDRY

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Switchboards Use Castings To Regulate Current

A NETWORK of wires rapidly is being spread over the United States to interconnect various central stations into enormous super-power systems and to enable the various public utilities generating electrical energy to give continuous service and to meet the peak loads. Increased facilities are necessary since each year sees a remarkable increase in the consumption of electrical current, due to a large extent to the demands being made by industry, which is finding it more economical to use the 24-hour service, which is offered by the electrical companies at a reasonable rate, than to attempt the operation of individual generating plants. The housewife also is increasing the demand for electrical current with such appliances as the washing machine, vacuum sweeper, iron, etc., and the use of electricity for street lighting, outdoor advertising and electric railway service is growing. In the generating stations, the substations where the voltage is stepped down, and in all buildings where electricity is used to any great extent, all control equipment and indicating devices are mounted on the switchboard. Products of the foundry may be found on the various pieces of switchboard equipment. Castings are used for instrument cases and for parts of the indicating mechanism, circuit breakers and switches.

Many Castings Are Used on Electrical Switchboards

Find Where Castings Can Be Sold.

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Brass Foundry Tests

EVERY HEAT

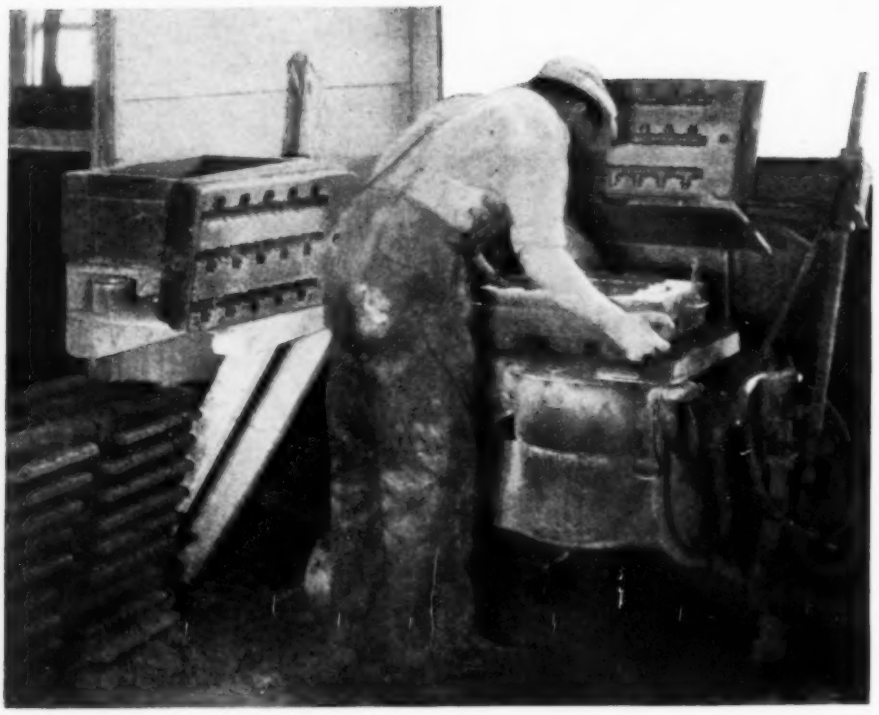


Fig. 1—Molding Machines Placed Under the Windows Enable Molders To Detect Any Defects in the Mold

By Edwin Bremer

LABOR-SAVING devices and metallurgical control now are established features of the modern brass foundry. The first lessens the drudgery of molding operations and yields a greater output for a given number of men and area. The second gives uniform products and improves operating conditions. This article describes one of the modern foundries using labor-saving devices and having complete metallurgical control.

ALTHOUGH brass today is a common alloy, employed for variety of purposes due to its beautiful golden color and certain physical properties, its origin is obscured by the mythological and historical veil that shrouds the early periods of mankind. Evidences of the use of copper and of bronze have been found in excavations of ancient tombs and inhabited sites, and in the writings of some of the old chroniclers. Doubtless, the discovery of brass making was accidental. Perhaps some curious primitive man in the dim past added rocks containing zinc carbonate or sulphide to those containing copper in his crude furnace and found that he had a yellowish colored metal instead of the more familiar red metal of copper or bronze.

Its golden color may have led him to believe that he had discovered what all chemists later sought with diligence, the philosophers stone that would convert base metals into gold. On examining his new discovery he found that it was harder than either copper or bronze, and after many trials he was able to duplicate his first result by melting together rocks containing copper and those containing zinc which later became known as cadmia. The name brass is found in translations of the earlier books of Hebrew scriptures. Reference is made to fetters of brass with which Samson was bound; to the brazen armor of Goliath; to the vessels of brass which were cast for Solomon's temple, etc.; but it must be remembered that the word used for copper also was applied to its alloys. Hence since we know that only copper is found native, the biblical brass may have been copper.

Aristotle, a famous greek philosopher who lived from 384 to 322 B.C., stated that people inhabiting a country adjoining the Euxine sea made their copper a beautiful white color by mixing or cementing it with an earth found there and not with tin as apparently was the custom. Strabo, a Greek geographer, who was born 54 B.C. and died in 21 A.D., mentioned that the Phrygians prepared an alloy of copper and zinc by calcining certain earths found in the neighborhood of Audera. Other historians in the time of Augustus speak distinctly of cadmia and its property of converting copper into aurichalcum, under which title the zinc alloy subsequently was known. Panadius Dioscorides, a Greek physician who lived in the first century, A.D., gives a description of securing pompholyx or zinc oxide, and indirectly an indication of making brass when he wrote: "The soot flies up when copper refiners sprinkle cadmia over the molten metal."

Ancients were accustomed to use zinc ores in the preparation of brass, but were not familiar with zinc in the metallic state. Alchemist Paracelsus in 1541 mentions metallic zinc, but it probably was known before that time and may have been discovered by Albertus Magnus who called it marchasita aurea. Metallic zinc regularly was manufactured in Germany about 1720 and in England 15 or 20 years later. The manufacture of brass was introduced into Germany in 1550 by Erasmus Ebener, an artist of Nuernberg, who prepared it by fusing copper with tuita fornacem or furnace cadmia. For years this pro-

cedure was followed and the first brass made by the direct fusion of copper and metallic zinc or spelter with or without the inclusion of calamine, zinc carbonate, was produced in England in 1781 by James Emerson who obtained a patent for his method.

The first brass casting in this country is said to have been made at the iron foundry of John Winthrop at Lynn, Mass., shortly after 1644. For fifty years after 1725 Casper Wistar, his associates and successors, hammered out stills and kettles of both brass and copper and cast some brass wares in Philadelphia. Brass cannon were cast before the Revolutionary war at Lynn, Mass., and at Philadelphia. In the natural course of events, the making and casting of brass spread to other parts of the expanding colonies, and was carried forward with the settlers, grew with the country's development, until at present more than 3600 nonferrous foundries may be found in the United States.

As previously mentioned, the first brass made from spelter and copper was produced in England in 1781. This was a great improvement over the older method under which zinc additions were made by adding ores. It is common knowledge that ores vary in metallic content and carry numerous impurities. Refining the ore for its metal content eliminates many of the impurities or gives a definite relation between the metal and its impurities. Therefore, using metallic zinc in making brass, enabled the old brass makers to duplicate their results and gave the necessary impetus to develop their own particular formulas which were held as trade secrets.

Secrets No Longer

Eventually, many closely held trade secrets became known to others than the originators and this led to the establishment of other foundries. This developed greater competition and consequently an improvement in product. Investigations were made on mixtures, melting and molding practice. Rule of thumb and guessing were eliminated and foundrymen became familiar with the proper procedure to obtain more uniform results. When the clear and revealing light of metallurgy and chemistry were focused upon nonferrous metals, many of the foundrymen established such scientific departments in their foundries to determine the best mixture for each purpose, to see that the mixtures were melted properly and to advise on the best molding practice.

This progressive step was of inestimable value to the nonferrous industry and put its products upon a higher plane of merit. Naturally, the consumers of brass castings are benefited not only by obtaining better castings, but also they are enabled to receive the benefit of advice, the result of experiment and experience, on the best mixture for the conditions to which the casting will be exposed or subjected.

A modern brass foundry that maintains a most complete metallurgical and chemical department according to present day standards is the Mueller Brass Co., Port Huron, Mich. This plant was established in 1917 for the express purpose of producing munitions for the World war and at that time was a branch of the H. Mueller Mfg. Co., Decatur, Ill., now known as Mueller Co. In April, 1927, O. B. Mueller and his son Bernhardt liquidated their interests in the other plants of the firm and obtained control of the Port Huron plant which then was incorporated as a separate firm.

The plant occupies an area of about 62 acres and embraces a foundry, a rod and tube mill for the extrusion and drawing of brass rod and piercing of seamless tubes, both brass and copper, automatic machine department for the manufacture of a variety of machined parts, a forging department for making forged brass goods and a casting shop equipped with electric furnaces for producing billets. The foundry is housed in a brick and steel sash building 80 x 140 feet. The steel sash provides excellent lighting and ventilation of the foundry and a monitor extending the full length of the building also assists in maintaining a clear atmosphere in the shop during pouring.

Fig. 2—Below—The Foundry Obtains Ample Light and Ventilation from the Windows in Sides and Roof Monitor

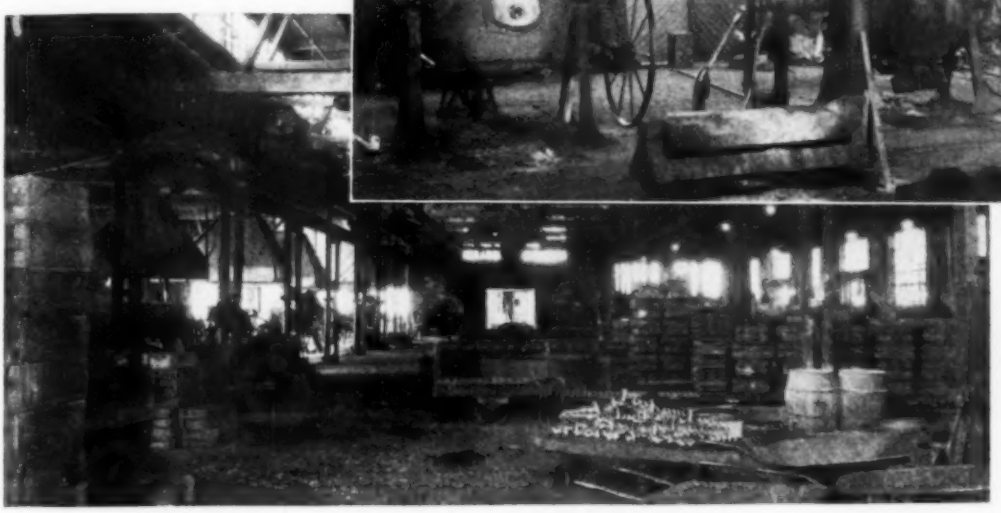


Fig. 3—Above—Large Hoods Carry Away the Fumes

The foundry extends north and south. The office and the sprue cutting, grinding and tumbling mill departments are located in the west end of the building. The melting furnaces are placed along the west side and the molding is done on the east side of the foundry. An excellent idea of the arrangement of the shop may be seen in Fig. 2 which is taken from the south end of the building. Metal is melted in six oil-fired, open-flame, non-crucible furnaces manufactured by the Hawley Downdraft Furnace Co., Easton, Pa. Four of the furnaces are 42 inches in diameter and have a capacity of 1000 pounds each and two are 60 inches in diameter with a capacity of 2500 pounds each. Fig. 3 shows one end of the row of furnaces. The furnace at the right is tilted for charging, the center one is in blast and the one on the left just has been charged. After the blast is on for a short time, the scrap protruding through the charging door melts, the door is closed and clamped and the furnace rotated until the pouring spout is pointed vertically upward. The spout remains in this position until the charge is melted. Then the furnace is turned until the spout assumes a horizontal plane, when it is ready for pouring.

Metal from which the charges are composed is kept in a separate building just across a driveway from the foundry. Here, the ingots, scrap and returned sprue and runners are segregated in separate compartments according to analysis. The component materials for each mixture are weighed in this building. After the correct amounts of ingot, scrap and sprue are weighed, they are transported to the proper furnace and dumped behind the furnace. From the floor the mixture is charged into the furnace.

Fumes Carried Out

A large hood is suspended above each furnace, as may be noted in Fig. 3. The hood terminates in a large diameter pipe which extends well above the roof of the foundry and carries off the obnoxious fumes which are ever present when metals containing zinc are melted. The ladle preheater may be seen just in front of the post on the right of the same illustration. This consists of a heavy cast-iron ring with four projections on which the ladle, a graphite crucible, rests. The ring is supported by three angle iron legs. The ladles are heated by an oil burner mounted vertically, nozzle upward in the center of the ring. The pig bed is plainly shown in front of the post in the center of Fig. 3. This contains an iron mold, with 12 ingot impressions, which is mounted on trunnions for easy dumping. Any cold or over metal is poured into this bed. Test bars are poured from each charge melted and these are forwarded to the laboratory for chemical or physical examination, or for both.

Labor-saving devices are much in evidence in the modern foundry. The backbreaking conditions of carrying and handling molds and flasks are alleviated and a greatly increased output is secured per man with a saving in the amount of floor space involved. A typical example of this feature is exhibited in the foundry of the Mueller Brass Co. as may be seen in Fig. 5. This shows the employment of roller conveyors instead of the usual sand floor with skids to which the molds with their bottom boards are carried by the molder.

As previously stated, the molding floors are arranged along the east side of the foundry building, and extend from the wall to the center. Seven floors are provided, each containing a molding machine, gyratory riddle for the sand and two conveyors.

Fig. 5—Below—Roller Conveyors Relieve the Molder from Carrying Molds to the Floor

Fig. 4—Above—Small Cores Rapidly Are Turned Out at the Core Benches

The conveyors, manufactured by the Mathews Conveyor Co., Ellwood City, Pa., are the roller type and are approximately 40 feet long and 2 feet wide. When full, the conveyors will hold about twenty-seven 18 x 24-inch steel flasks. The molder places the first completed mold on the end close to his machine and gives it a slight push which carries it a short distance. The second mold follows and forces the first a little farther along, and likewise each mold in turn moves the preceeding molds until the conveyor is full. Then the molder places his molds on the opposite conveyor. Pressed steel flasks made by the Sterling Wheelbarrow Co., Milwaukee, are employed.

Molding machines manufactured by the Osborn Mfg. Co., Cleveland, are the jolt-squeeze, pattern-draw type and are located at the end of the floors under the large steel sash windows. This gives the molder plenty of light and he is able to see at once any defects in the mold surface. The machines are placed to one side of the space allowed; the sand occupying the remainder. Molders give their undivided attention to the production of molds. Pouring, shaking out, and sand preparation are cared for by a separate gang.

Production per man depends to a great extent upon the type of casting produced and is given as 100 to 120 molds per day with cored work and 160 to 200 molds if solid. All the patterns are mounted on matchplates, that is, one plate contains the two halves of the pattern mounted on the top and bottom of the plate. Since the castings generally are small, several patterns are mounted on the same board as may be noted on the matchplate in Fig. 1.

Procedure of molding follows the usual plan in vogue on this particular type of molding machine. The whole flask is placed on the platen of the machine and is opened drag side up and the pattern lowered on the pins. The pattern and drag flask are then turned over by the molder on to the cope flask. He then riddles some sand on the surface of the drag half pattern which now is uppermost. Heap sand is shoveled on and the mold is jolted. After placing a bottom board in position the molder rolls over the flasks. Sand is riddled on the cope half pattern which now is turned upward. Heap sand is shoveled on and the sand around the walls of the flask rapidly is peened with the shovel handle. Sand is piled several inches above the top of the flask and the whole is squeezed. The molder then raps the pattern plate with the aid of a vibrator and removes the cope which he places on the shelf at his left. The pattern is drawn and placed on top of the machine as shown in Fig. 1 and the mold floured by shooting a jet of compressed air through the flour bag. Cores are placed in position, the cope replaced and the completed mold is placed on the conveyor as mentioned previously.

Shake Out Castings

When the conveyor is full of molds, the weights are placed on the molds and pouring is commenced. Fig. 5 shows some of the molds ready for pouring. After the metal has solidified the castings are shaken out and cores blown. The sand is then carried back to the heap and prepared for re-use. Pouring, shaking out and sand preparation is handled by a separate crew of seven men. Three of these do the pouring and the other four shake out the castings, knock out the cores, and send the flasks and sand back on the conveyor to the heap and prepare the sand for re-use. Knocking out the cores is accomplished by grasping the hot casting with a pair of tongs, inserting it in a large tank of water and giving the casting a sharp blow against the side of the tank.

The basis of this method of core removal is founded on the principle of steam formation when the hot casting comes in contact with the water. This action loosens all sand from the casting and the sharp rap against the steel side of the tank ejects the sand from the pockets in the interior of the casting. The tanks used for this process are about 7 feet in diameter and 7 feet deep with an overflow pipe about 6 inches from the top to prevent water from overflowing upon the floor. A 4-wheeled truck, placed close to the tank receives the cleaned castings and is used for transporting them to the south end of the foundry where the sprues and runners are removed and the castings are tumbled.

In shaking out, the sand is punched around the gate, the cope lifted off without disturbing most of the sand, and the casting removed. The cope and drag then are carried to the sand heap and dumped out. The flasks are piled to one side and the sand is wet to the proper moisture content, which previously has been determined by laboratory analysis to be best for the mixture of metal and type of casting. The moist sand then is shoveled into a gyratory riddle manufactured by the Great Western Mfg. Co., Leavenworth, Kans., which performs three operations. It mixes

Fig. 6—Sprue Removal, Grinding and Tumbling Are Done Before the Castings Are Inspected

the sand, removes any metal such as broken runners, and aerates the sand as the latter falls from the riddle to the heaps. All Albany sand is used to obtain the desired finish on the surface of the castings. Core sand for the cores is mixed in a machine manufactured by the Blystone Mfg. Co., Cambridge Springs, Pa. This is composed of portions of molding sand and silica sand, bonded with linseed oil. The sand mixer is located in the foundry and the mixed sand is conveyed to the coreroom. Cores are made by machine and by hand. Machines used in producing cores are manufactured by William Demmler & Bros., Kewanee, Ill., and the Wadsworth Core Machine & Equipment Co., Akron. Ohio. The coreroom shown in Fig. 4 is housed in a building adjoining the northwest end of the foundry and the core ovens are situated in the foundry just around the corner from the coreroom. Many of the core boxes are made of aluminum and the finished cores are turned out on plates or if of intricate shape are placed in driers shaped to fit the cores.

Oil-fired core ovens manufactured by the Foundry Equipment Co., Cleveland, are employed to dry the cores. The oil burners and regulating valves are located in a pit behind the ovens and between the brick wall that separates the foundry from the coreroom. The ovens are two in number and about 6 x 8 feet. They are what is known as the drawer type and the various drawers may be loaded and emptied without interfering with the drying of cores in the other drawers.

Removing Sprues

Final cleaning of the castings is accomplished at the southwest end of the foundry, shown in Fig. 6. Here the sprues and runners are removed either by a sprue cutting machine manufactured by the Tesmer Machine & Tool Co., Detroit, or by a band saw similar to those used in pattern shops. The sprue cutting machine will remove sprues up to ¾-inch in diameter. Larger sprues are sawed off on the band saw. Removal of sprues and runners generally leaves a rough spot on the casting where they were attached and these places and any fins on the castings are ground off on pedestal grinders, manufactured by the Diamond Machine Co., Providence, R. I.

After the sprues and runners are removed and the castings ground, they are placed in a tumbling barrel manufactured by the W. W. Sly Mfg. Co., Cleveland. The barrel then is filled with water and allowed to rotate. The combined action of the castings rubbing together and the water produces a smooth bright finish. If another type of finish is desired, the castings are placed in a sand-blast barrel manufactured by the Pangborn Corp., Hagerstown, Md., and finished by this method.

When the castings have been cleaned, they not only are inspected for surface defects but a casting from each heat is broken and the structure examined. All pressure work castings are air tested. This inspection is carried on in an adjoining room which is entered through the door shown at the back of Fig. 6. The castings are dumped upon steel topped tables and examined carefully by the inspectors. Any casting showing the slightest defect is discarded. The good castings are placed in boxes and forwarded to the shipping department for distribution.

Plate Castings With Nickel

Many nonferrous castings are supplied with a nickel finish. The Mueller Brass Co. maintains a nickel-plating department. To obtain the best appearance of a nickel plate or coating, the primary surface which is the casting, must be prepared carefully. If the finished coating is desired smooth and lustrous, the primary surface must be the same. Therefore, the cleaned and inspected castings are brought to the nickeling department where they are buffed, washed and nickeled.

Buffing consists in holding the casting against a wheel composed of layers of cloth closely held together and with the edges cut to a circular form. These cloth wheels rotate at a high rate of speed. The preliminary buffiing is aided by the use of tripoli compound of about the consistency of ordinary soap bars which is held against the wheel from time to time. Tripoli is a fine silicious material and exerts an abrasive action on the metal held against the wheel. When the casting attains the proper smoothness and polish under the action of the tripoli coated wheel, the object is given a final buffing on a plain cloth wheel. This removes any remains of the tripoli and produces a highly finished luster so necessary to fine plating finishes.

All traces of grease must be removed if the nickel coating is to adhere firmly to the base. The merest trace of grease such as might be left from perspiring hands may cause a defect in the nickel coat. Therefore, the buffed castings are placed on hangers or racks containing many hooks and these are immersed in a hot alkaline solution. This solution, or cleaner as it is called, removes all traces of grease.

The racks are removed from the cleaning solution and immersed in a bath of hot water to remove the alkali. The racks with their attached castings are allowed to drain for a few minutes and then are hung in the plating bath until a nickel coat of the proper thickness is deposited. The Mueller Brass Co. uses a continuous plating bath manufactured by the Meaker Co., Chicago. This machine has an endless chain to which the racks are attached and move slowly around the bath. The speed of the chain may be varied to meet conditions and with higher speeds the current density may be increased with a resulting increase in plating speed. The voltage employed in plating runs from 4 to 5 volts, and the amperage varies according to the surface exposed for plating.

After the articles are plated to the proper thickness, they are removed from the bath and allowed to drain. They then are placed in a hot water bath to remove all traces of the plating solution. After removal from the water bath, they are suspended to drain and the heat retained by the castings assists in drying them. If a highly lustrous finish is desired the nickel castings again are buffed. If the finish obtained in plating is bright enough, the objects are tumbled in sawdust to remove any vestiges of moisture, inspected and forwarded to the shipping room.

Analyze Heats

Previous mention has been made of the metallurgical and chemical supervision maintained by the company. Bars are made with every charge melted in the furnaces and these are sent to the laboratory for examination. Ordinarily, the check is maintained by chemical determination of the constituents of the mixture as represented by the test bar. Determinations of copper and lead are made by the electro-deposition method. A small sample is weighed accurately on a sensitive chemical balance and dissolved in a small quantity of dilute nitric acid. The solution is boiled to remove any nitrous and nitric oxide fumes and then diluted to about ten times its volume. A previously weighed platinum cathode and rotating anode are placed in the solution and the copper is deposited upon the cathode

(*Concluded on Page* 14)

700 TONS Daily Melt of Auto Shop

By Pat Dwyer

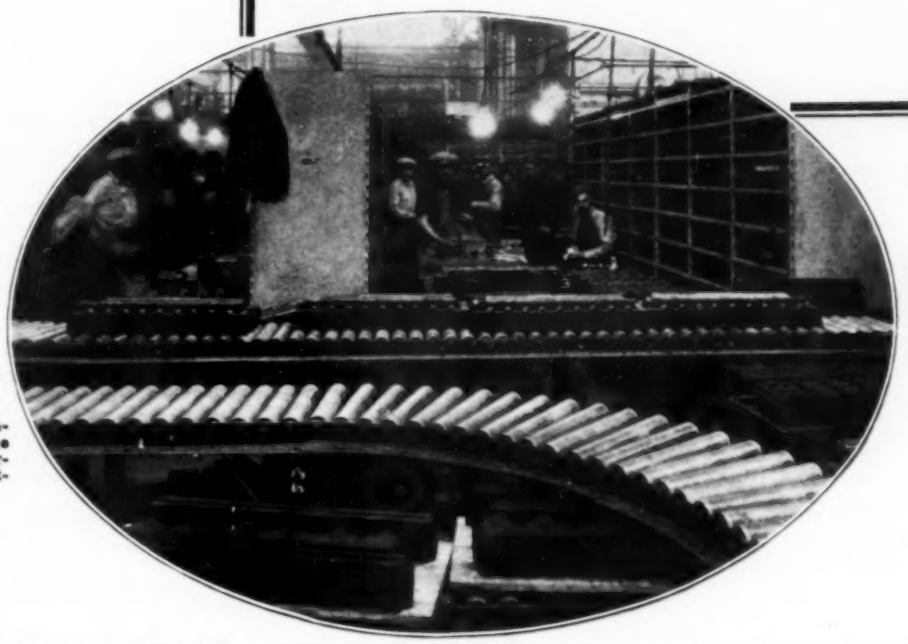


Fig. 1—Roller conveyors take all the burden off the operators in all departments

OPERATIONS are conducted on a huge scale and that an important place is taken by mechanical equipment in the gray iron foundry recently erected by the Buick Motor Co., at Flint, Mich., is evident from the fact that melting equipment has been installed capable of handling 700 tons of iron in the ordinary working day, or approximately 100 tons per hour. The pouring crew starts work an hour before the shakeout crew in the morning and naturally their positions are reversed at night when the shakeout crew has a conveyor filled with poured molds to handle after the pouring crew has concluded its labors for the day.

Two independent handling systems have been installed for conveying the

THIS is the third of a series of articles describing the methods and equipment employed in the gray iron foundry recently placed in operation by the Buick Motor Co., Flint, Mich. The first and second articles of the series covered general features, molding and sand handling. The present article deals with the melting and coremaking departments. A fourth to appear in a future issue will detail interesting features in transportation and cleaning.

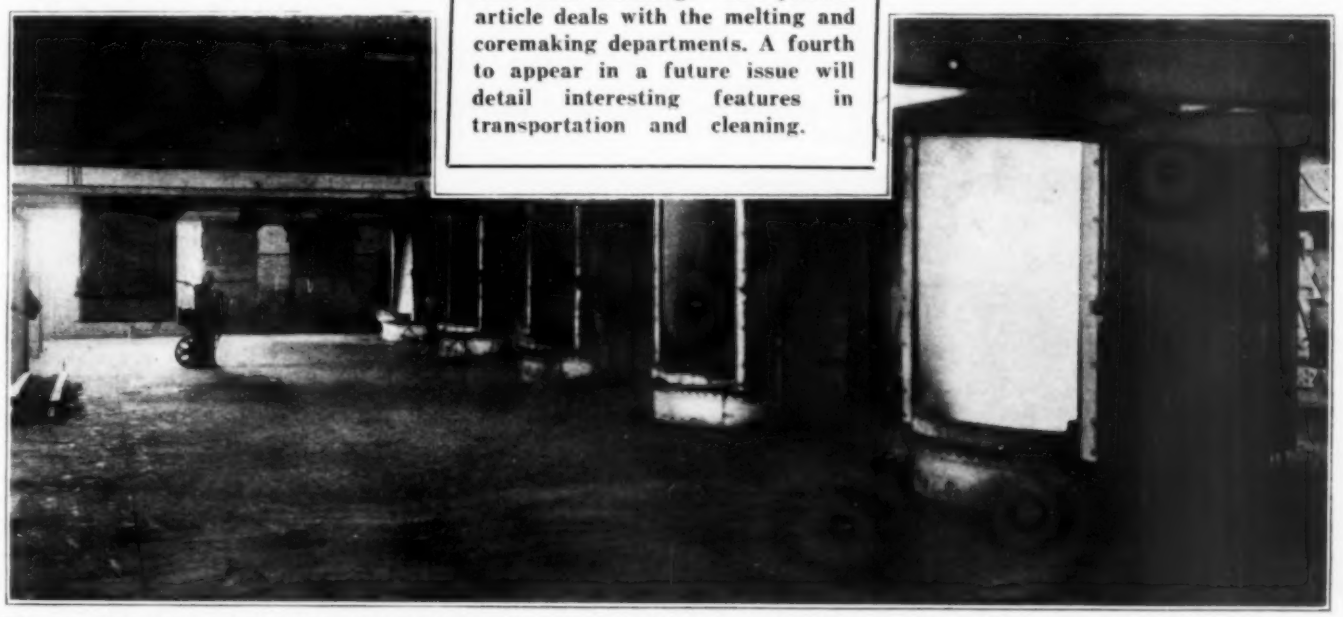


FIG. 2 A COMBINED BRIDGE AND HOIST LIFTS THE LOADED BUCKET FROM THE GROUND FLOOR AND DISCHARGES IT INTO ANY ONE OF THE BATTERY OF SIX 82-INCH CUPOLAS

FIG. 3—CHARGING BUCKETS ARE SPOTTED UNDER TUBES LEADING TO THE CHARGING FLOOR

raw materials from the stockyard into the battery of six cupolas. One system is devoted exclusively to the transportation of pig iron, gray iron and steel scrap. The second system, electrically operated and controlled automatically, supplies the cupolas with coke and limestone. Each cupola is provided with two large charging doors, set opposite each other. The iron is charged through one door and the coke and limestone are charged through the other. In one respect, at least, the cupola charge resembles a widely advertised piece of household equipment, no human hand touches it during preparation and it is delivered in the original package.

Pig iron and scrap to the extent of several thousand tons constantly are maintained in piles in the stockyard approximately 70 x 500 feet and located adjacent and parallel to the foundry on the east side from which it is separated by the building housing the cupolas and the equipment for making up and weighing the charges. The stockyard is spanned by two 5-ton cranes made by the Harnischfeger Corp., Milwaukee, equipped with magnets for unloading the railroad cars and depositing the material in certain designated areas.

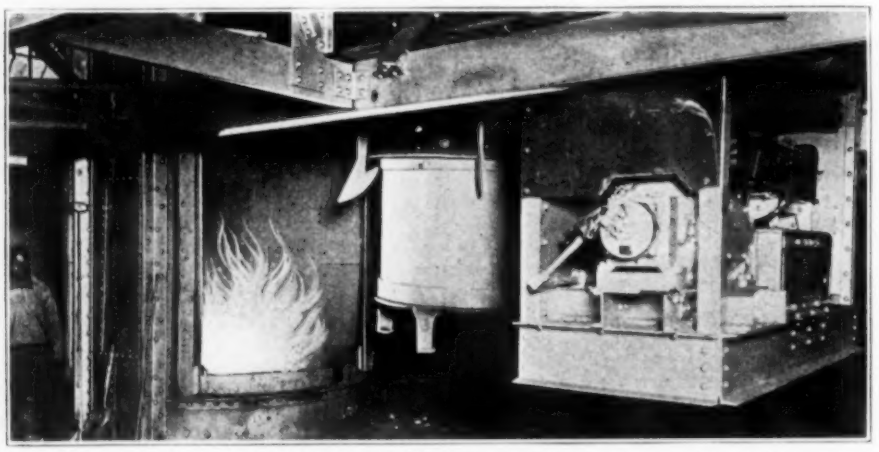


FIG. 4—A SECOND SET OF HOOKS ENGAGE THE RIM AND LIFT THE BODY OF THE BUCKET FROM THE BOTTOM AND THEN THE LOAD SLIDES FROM THE HIGH CONE IN THE CENTER

Effort is made to preserve uniformity in this classification, but concessions are necessary from time to time, depending on many factors, including market quotations.

Cognizance is taken of this feature in issuing instructions for making up the charges. A new sheet is posted every day, for the direction of the cranemen in transferring materials from the various stock piles to the charging cans. Anticipated analysis of the iron must conform to a close and definite standard, but conceivably iron to meet this analysis may be produced from several possible combinations of pig iron, gray iron and steel scrap. For example iron for the cylinder blocks must approximate the following analysis: Silicon 2.30 per cent, sulphur 0.10 per cent, phosphorus 0.20 per cent, manganese 0.70 per cent. Materials in the yard fluctuate in chemical and physical

FIG. 5—CORE RACKS ARE SUSPENDED FROM A CONVEYOR WHICH PASSES THROUGH A LONG OVEN

characteristics from day to day and these changes must be familiar to and taken into consideration by the plant metallurgist who makes up the cards for the guidance of those directly handling the materials.

Methods and equipment for assembling, weighing and charging the materials into the cupolas differ in many respects from those in use elsewhere. Individual features of the process have been duplicated in other foundries, but the entire process as at present in use at the plant of the Buick Motor Co., probably is the only one of its kind in existance. All the preliminary work is done on the ground floor. No material is handled or stored on the charging floor, which as may be noted by referring to Fig. 2 is of comparatively

restricted area. Each made up charge as it arrives above the level of the charging floor is moved forward and dropped directly into one of the six cupolas.

Metal charges are made ready in a continuation of the cupola building in which the principal features are illustrated to the right in Fig. 10. A row of heavily reinforced bins occupies the space inside the wall. A steel apron extends upward on a slant from the bottom of the bins and through an opening in the wall. It extends outward far enough to receive iron from the magnets suspended from the two stockyard cranes. The different bins are numbered and in that manner a preliminary sorting of material is effected in the first general movement of material toward the cupola.

Three special type cranes made by the Chisholm & Moore Co., Cleveland are employed in actually collecting and assembling the materials into individual charges of 4000 pounds. Each crane is equipped with a magnet and a scale by which the exact amount of each variety of iron is lifted and weighed before it is dropped into any one of a row of 14 hoppers. This arrangement allows four hoppers to each of the three cupolas in commission on any one day, with two spare hoppers available for any emergency.

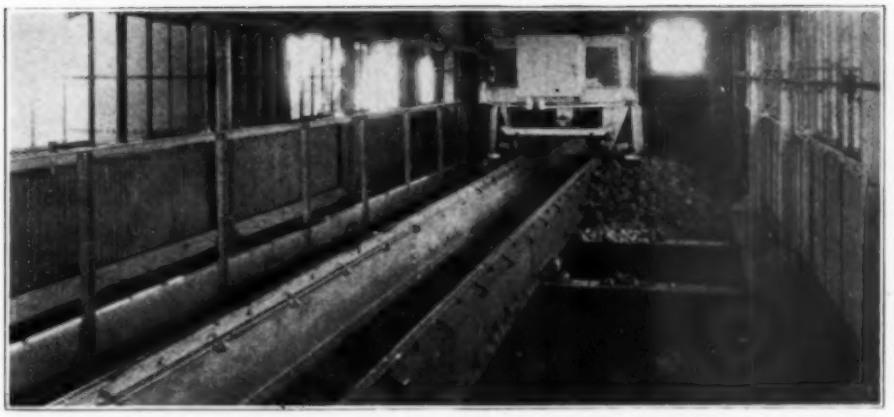


FIG. 7—COKE BINS ABOVE THE CHARGING FLOOR ARE LOADED BY A LARRY CONTROLLED AND OPERATED AUTOMATICALLY AND ELECTRICALLY

FIG. 6—HEAD CORES ARE ASSEMBLED, INSPECTED AND GAGED ON ROLLER CONVEYORS

Circular steel charging cans with collapsible bottoms are placed under the hoppers and filled by depressing a lever which releases the gates on the bottom of the hopper. Three lift trucks made by the Automatic Transportation Co., Buffalo, are employed in transportating the charging cans from the filling station to a point back of the cupolas.

In the original installation a turntable mounted flush with the floor back of each cupola was designed to receive the loaded charging cans. Each can was deposited close to the edge of the circle as shown in Fig. 3 and was picked up by a crane hook which came down through a 5-foot diameter tube extending upward from the bottom of the mezzanine floor to the level of the charging floor. One of these cranes is located in front of each cupola in the charging room and is controlled from the floor. When a can is spotted on the turntable on the ground floor, the crane hook is lowered until it engages a heavy steel loop attached to the bottom of the can and extending upward a sufficient distance to clear the material forming the charge.

The crane operator on the charging floor stands in a position where he can look down through the tube and see that the hook is engaged. The can then is hoisted to a point about 4 feet above the charging floor, or until the top is flush with the lower edges of the crane girders. At this stage the load is moved forward and into the cupola. Four hooks on an auxiliary hoist engage the rim of the can which is attached to the body. The main hoist hooked to the loop supporting the bottom, then is slacked off and as the bottom of the can sinks away from the body, the material forming the charge falls into the cupola. The position of the can may be adjusted at any point in the cupola between the charging door and the bottom. The bottom of the can terminates in a cone in the center and this form of construction effectually discharges the load, besides spreading it uniformly in the cupola.

After the cupola has been filled to the door sill the various succeeding charges are discharged at that level, but filling the cupola at the start, the cans are lowered a considerable distance to ease the fall of the material. Each iron charge is made up of 4000 pounds and with the accompanying charge of 500 pounds of coke, seven complete charges are required to fill the cupola to the door

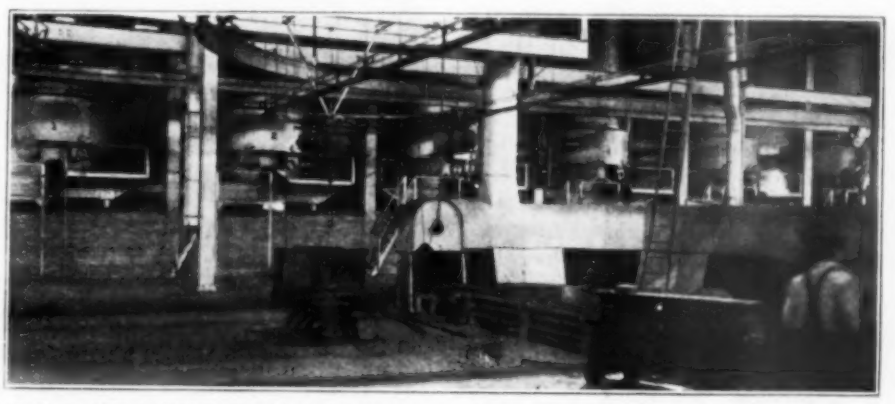


FIG. 8—SIX 82-INCH CUPOLAS ERECTED IN LINE AT THE SOUTHEAST CORNER OF THE FOUNDRY BUILDING ARE OPERATED IN ALTERNATE BATTERIES OF THREE

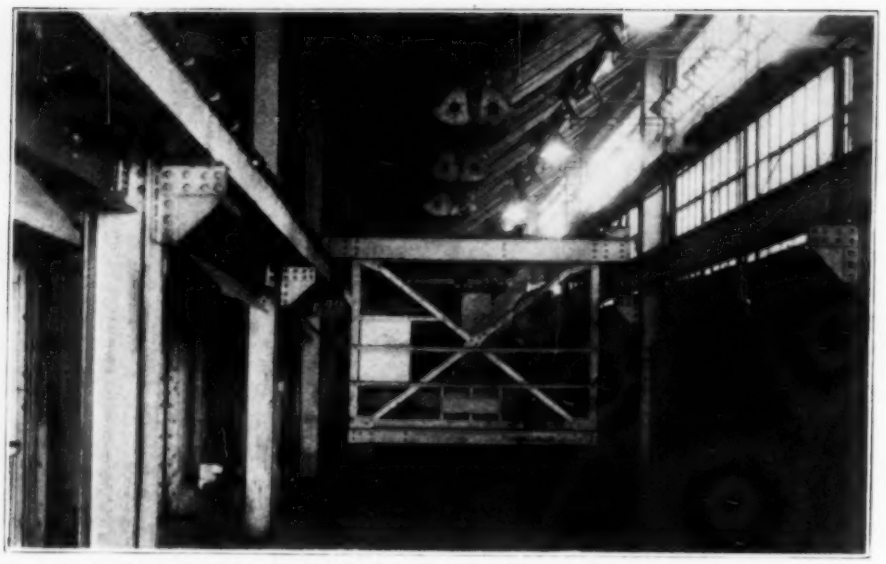


FIG. 9—A COKE CHARGING MACHINE TAKES A MEASURED AMOUNT OF COKE FROM THE OVERHEAD BINS AND DISCHARGES IT INTO THE CUPOLA

sill. Each of the six cupolas built by the Whiting Corp. Harvey, Ill., is a duplicate of the others, 96 inch shell lined first to 78 and later to 82 inches and calculated to melt about 25 tons per hour for a period of 9 hours per day.

In the foundry as elsewhere the best laid plans of men and mice gang aft agley when the operators actually doing the work discover an easier or quicker method than that originally contemplated. A clever engineer designed and installed the turntables in the ground floor behind each cupola. In theory the truck driver was to deposit a loaded can close to one edge directly under the tube leading upward to the charging floor. While the first can was aloft the driver was to place a second can on the opposite side of the turntable. The emptied can was to be lowered to place, the turntable was to be swung through a half circle thus bringing the second can under the hook of the charging machine on the third floor. The driver was to pick up the empty can, take it to the loading station shown in Fig. 3 and return with a full can and repeat the cycle constantly throughout the duration of the heat.

Drivers Bump 'em

Each driver soon discovered that he could do the work without leaving his perch on the truck and without moving the turntable. Assuming that the first loaded can has been taken aloft, the driver arrives with a second can and waits close to the edge of the turntable until the empty can descends. The moment the hook is disengaged the truck moves forward and pushes the empty can far enough to provide space for the reception of the loaded can. The empty can slides readily on the face of the turntable. While the second can is aloft, the truckdriver takes the empty can to the loading station and returns with one that is loaded and repeats the sequence as often as necessary during the day.

Six cupolas arranged in a straight row and close together are designed to be used in batteries of three on alternate days. The fire is lighted in each cupola at 2 a.m., charging commences at 4 a.m. and the first iron is tapped at 6 a.m. Two views of the cupolas are shown in the accompanying illustrations. In the front view shown in Fig. 8 it may be noted that a brick curtain wall 6 feet high extends across the front of the entire battery. This prevents any splashing of molten material when the bottom is dropped from the various cupolas. A second wall a short distance back of the cupolas and extending up to the mezzanine floor serves as an effective bulwark in preventing the slag from annoying the truck drivers dashing back and forth with loaded and empty charging cans.

A short steel stairway equipped with hand rails and located on the outside of the curtain wall, gives access to a hand railed steel platform which encircles each cupola at the level of the spout. Protected by leggings and goggles the cupola tender stands on this platform and taps the breast in comparative safety. Also he has opportunity to walk around and peep in through the various tuyeres to note melting conditions. A sufficient amount of iron is retained at all times in the well of the cupola to keep the slag flowing freely. The iron distributed through the foundry must be poured at a high temperature, therefore it is tapped directly into 2000-pound ladles. Melting at the rate of 25 tons per hour it is apparent that the cupola must be tapped approximately every 2 minutes throughout the day.

Use Three Door Props

Safety features have been incorporated so far as possible in all equipment connected with the cupola department. The two half drop doors in each cupola are lifted into place by a chain hoist and held there by three props resting on a solid concrete foundation. The two outside steel props terminate at the upper end in jackscrews by which the props may be adjusted nicely to take the weight of the doors. A third prop with an eccentric hinge in the center then is placed upright under the center of the door. At the conclusion of the heat the jackscrews are

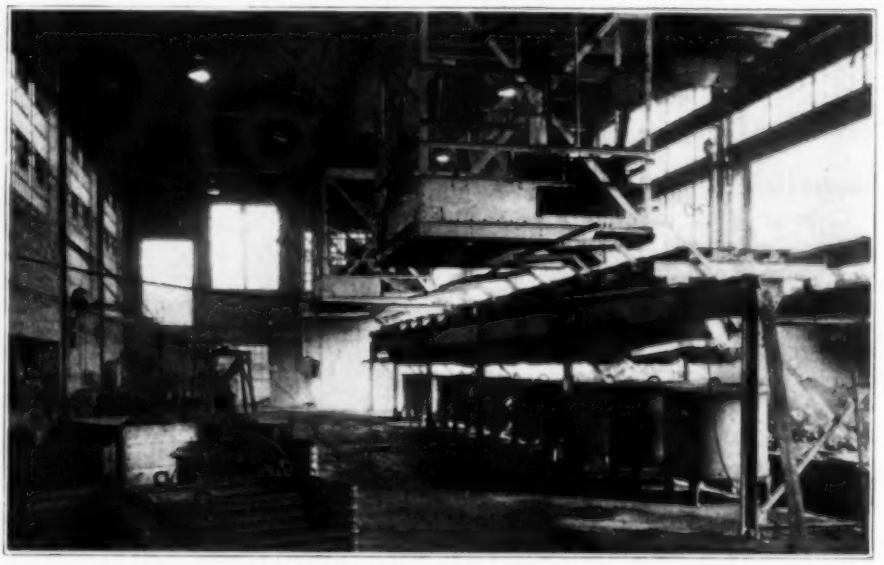


FIG. 10—CHARGING BUCKETS ARE LOADED UNDER A BATTERY OF HOPPERS INTO WHICH THE MATERIALS FOR THE CHARGES HAVE BEEN WEIGHED

slacked sufficiently to release the weight of the doors which is taken by the prop in the center. The two outside props are removed. Then a long hooked bar is employed to trip the center prop, which doubles in the center like a jack knife and allows the two half doors to fall from under the comparatively small amount of material remaining in the cupola at the conclusion of the heat.

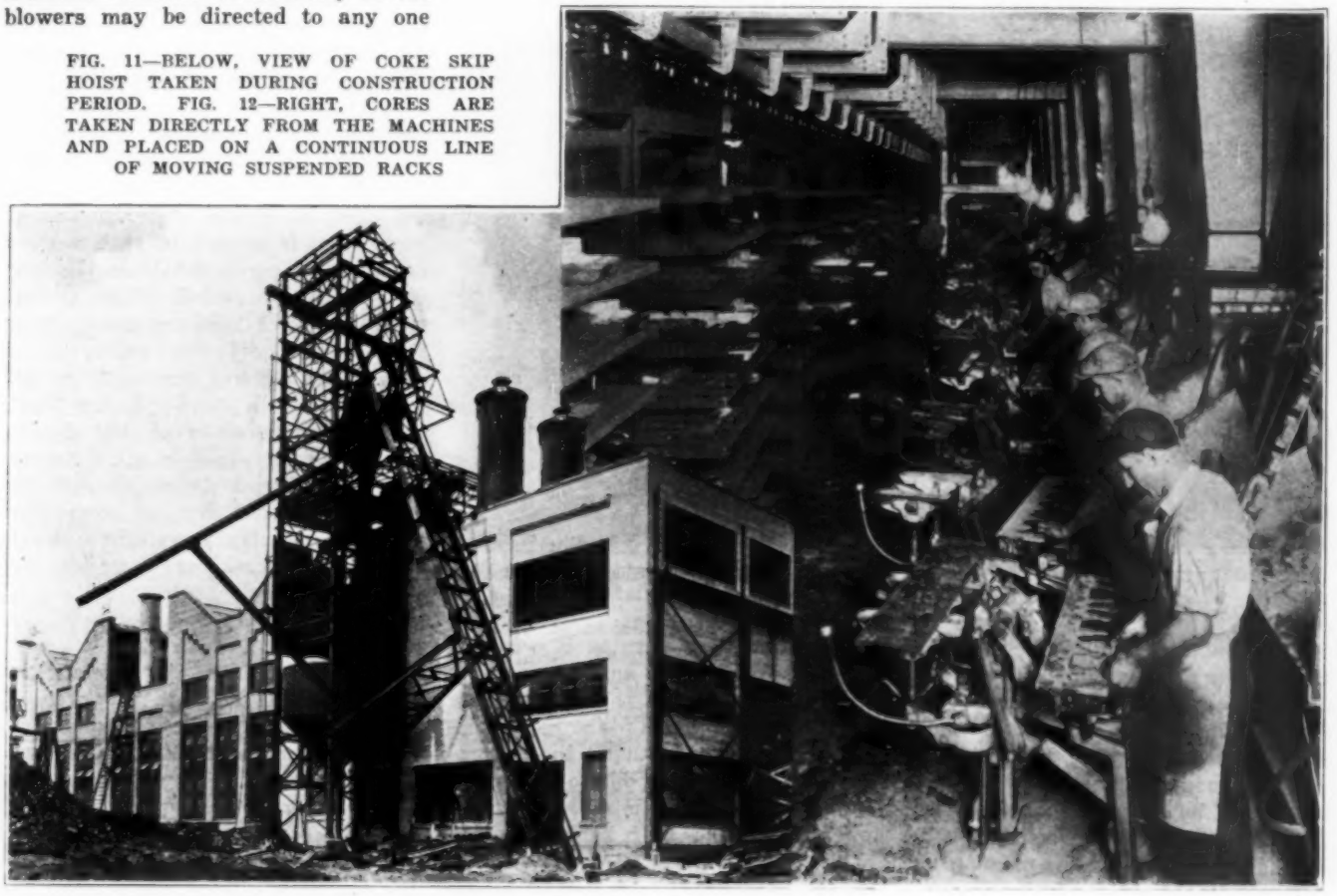
The second floor in the cupola department supports a battery of five positive pressure blowers made by the Wilbraham-Green Blower Co., Pottstown, Pa., each blower driven by an individual motor supplied by the General Electric Co. The main blast pipe and the branches leading to the various cupolas are arranged in such a manner that blast from any of the blowers may be directed to any one of the cupolas. The branch pipe leading to each cupola is 25 inches in diameter and enters the windbox surrounding each cupola at a tangent. Blast is supplied at 16 ounces pressure and at approximately 13,000 cubic feet per minute. The 5-foot tubes referred to previously through which the charging cans are raised and lowered, extend from the mezzanine floor to the charging floor and prevent contamination of the air in the vicinity of the blowers. Intake pipes for the blowers are located immediately under the mezzanine floor and may be seen in Fig. 3. An outside view of the southeast corner of the cupola building is shown in Fig. 11. This picture was taken during construction, but the position of the windows shows the position of the three floors.

Skeleton of the tower and skip hoist for conveying coke to the cupola bins is shown in the same illustration. The coke handling equipment was designed and installed by the C. O. Bartlett & Snow Co., Cleveland. Through a series of switches the entire operation of transferring coke from the storage hopper under the railroad track on the outside of the building to the row of storage bins located above and to the back of the charging floor, is performed automatically. The upper side of these storage bins with the transfer car in the distance is shown in Fig. 7. The under side of the same bins showing the gates through which the coke is dropped into the coke charging machine is shown in Fig. 9.

Coke arriving in drop-bottom gondolas is discharged into a steel hopper located below the railroad track. The bucket on the skip hoist descends to a point below the bottom of the hopper and comes to rest in such a manner that it trips a lever which opens the gate in the hopper. The tripping device is attached to a counterweight in such a manner that when a definite amount of coke is in the bucket, the trigger is released. The hopper gate is closed and a motor is set in motion which sends the bucket to the top of the incline. Here the bucket automatically is dumped and the coke falls into the waiting car shown in Fig. 7. On its way to the car the coke slides over a grating which removes all the coke breeze. This fine material falls into the hopper which may be noted near the bottom of the structure in Fig. 11. After a considerable quantity accumulates it is discharged through a nozzle in the bottom into a truck backed under for the purpose.

Operation of the bucket on the skip hoist and the larry which receives the coke and distributes it to the various storage bins, is synchronized through a set of contact switches. Thus the larry always is present at the bottom of the grating when the bucket on the skip hoist discharges its load at the top. The larry operates on a track above the coke and limestone bins located on the opposite side of the battery of cupolas to that occupied by the machines engaged in charging the iron. An ingenious device automatically stops the larry over any designated bin, trips the bottom doors so that the coke falls into the bin, then starts the larry on the return journey and closes the

FIG. 11—BELOW, VIEW OF COKE SKIP HOIST TAKEN DURING CONSTRUCTION PERIOD. FIG. 12—RIGHT, CORES ARE TAKEN DIRECTLY FROM THE MACHINES AND PLACED ON A CONTINUOUS LINE OF MOVING SUSPENDED RACKS



doors while on the return passage.

Three charging machines suspended from tracks in an alley back of the cupolas and equipped with scales for weighing the amount accurately, are employed for transferring the coke from the storage bins to the cupolas. The machines were built by the Chisholm-Moore Co., Cleveland and are somewhat similar to the machines made by the same company for charging the iron on the opposite side of the cupolas. The coke charging machines are free to travel from one end of the building to the other and may be utilized to charge any of the furnaces. Limestone is dumped in a pile near each furnace and is shoveled in by hand, approximately 200 pounds to each charge.

The core making department 123 x 260 feet occupies the north end of the foundry building as shown in the plan which accompanied the first article in this series published in the Nov. 1 issue of THE FOUNDRY. A steel floored gangway, 20 feet wide and extending across the building separates the coreroom from the row of shakeout machines which mark the northern boundary of the molding and pouring department. Three main conveyors which carry cores from the coreroom to the molding stations, travel under this gangway on their passage to and fro.

Methods and equipment in the coreroom have been designed and arranged in a manner to keep materials moving steadily in one direction. Concrete bins located on the east side and adjacent to the coreroom, provide accommodation for 60,000 tons of new core sand, approximately a year's supply at an anticipated consumption of 200 tons per day. One third of this supply is a sharp bank sand. The remaining two thirds is a fine, uniform, silica sand from the dunes along Lake Michigan, a sand that is used exclusively in automobile foundries in the middle west. This sand is cheap and plentiful, therefore no attempt is made to add old sand to the mixture.

Another feature affecting the selection and use of all new sand is that finished cores must show high permeability and strength with a minimum amount of core binder. Addition of burned sand without special treatment would defeat this object. It is claimed special treatment of old sand would entail as great expense as the use of new sand.

Core sand is prepared according to two standard formulas. Water jacket cores are made from one mixtures. All the other cores are made from the second mixture. On account of the precarious position it occupies, where refractoriness and permeability are prime requisites, the water jacket core is made from lake sand exclusively, bonded with oil in the proportion of 1 part oil to 55 parts sand. The second mixture is made up of half and half bank and lake sand with 3 parts oil and 3 parts of a proprietary dry, core binder to every 200 parts sand. The bank sand and dry binder are added mainly to give the cores a *body* and help them retain their shape while in the green state.

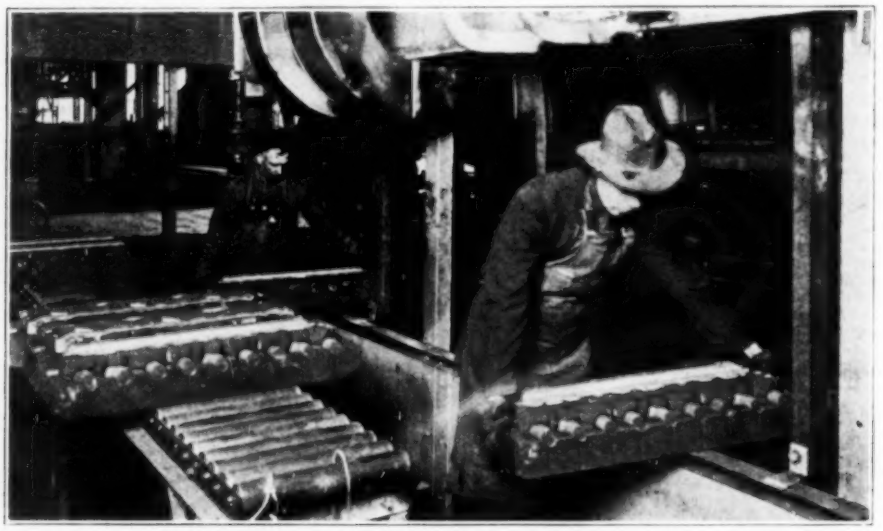


FIG. 13—AFTER THE HEAD CORES ARE ASSEMBLED, WIRED, PASTED AND BLACKWASHED THEY ARE REDRIED IN A MOVING TYPE VERTICAL OVEN

On account of the thin metal sections on all the castings, the cores are held within exceedingly close limits and must pass the rigid inspection of many operators before they finally are placed in the molds. A regular inspector passes on the cores before they are allowed to enter the assembly line. Every person in the line is a self constituted inspector to detect any defect in the face of the core, or any variation in size or shape. Payment is on a piecework basis and naturally each operator is on the alert to see that he or she is not the loser through mistake or negligence on the part of a fellow operator.

Core sand is prepared in a battery of six, paddle-type mixers made by the Standard Sand & Machine Co., Cleveland, equipped with automatic devices for measuring the amount of sand and binder for the batch. The requisite amounts of oil and water are sprayed on the mass of sand while it is in motion. Succeeding batches of sand are discharged through an opening in the bottom of each mixing trough and conveyed by belt to a storage hopper from which a constant supply is sent out to the various core benches. A typical core bench with a small individual supply hopper over each man's stations is shown in Fig. 12.

Nine continuous type oil fired ovens designed and erected by the Young Brothers Co., Detroit are utilized for drying the cores. Each oven is 145 feet in length and the moving mechanism is geared in such a manner that the cores remain in the oven for a definite period. The elapsed time in which the conveyors move through the different ovens varies from 3 to 4 hours depending on the character of the cores. A practically uniform temperature of 450 degrees Fahr., is maintained in all the ovens and naturally a longer baking period is required for an oven filled with thick, bulky cores, than one in which the cores are smaller and lighter.

Carried on Rollers

Speed at which the loaded core carriers travel through the oven determines the number of coremakers required for each unit. The racks are unloaded as they emerge from the south end of the oven. Obviously they must be reloaded on the return journey before they once more enter the north end of the oven. The number of racks available, divided by the capacity of each man in a given period gives the number of men required. For example if 40 racks pass the core making station in a 4-hour period, and if one man can fill two racks in that time, it is apparent that 20 men are required to keep the oven working to capacity.

Sequence of operation in this as in every department of the plant is divided among many men. Thus the duties of the coremaker proper are confined to filling the corebox with sand, adjusting wires where neces-

(*Concluded on Page* 41)

Advises Simple Chemistry

Apprentice Educator Believes Fundamental Course Will Improve Proficiency of Foundry Workmen

By W. Armstrong

ALL up-to-date foundrymen agree that chemistry is an absolute necessity in the modern foundry producing iron, steel, brass or other castings.

Now if all are convinced that no foundry can be operated successfully without the aid of a chemical laboratory or of a practical working knowledge of chemistry either directly or indirectly related to its particular product, why is not chemical knowledge instilled into the minds of apprentices, with an appreciation of its importance to the trade they are learning? Why not let that basic idea be expanded with the development of the apprentice?

The object of this endeavor should not be to try to make every apprentice a chemist, but to give each potential foundryman an insight into the bearing that chemistry has upon his work. The average apprentice need not go any further than this, but if taken thus far his outlook will be broader and he will be more efficient. In many cases this fundamental knowledge of chemistry would encourage the young man to seek deeper and interest is at the root of all progress. It is that striving to better one's own condition from self-seeking motives that has led men on to success, and has given the world advancement. It is a laudable ambition to try to improve one's self, and to rise by acquisition of knowledge. It is this quality of a man's character, coupled with self respect, self confidence, and proper self seeking that raises him above his fellows. There is no such thing as equality in this world. No man wants to do, or ever does something for nothing and every individual is expecting some recognition for his service. It may be money, it may be goodwill, it may be praise, or honor, but every normal person wants something. Industry should promote this selfish ambition, if it is to get the best out of the workers.

Few men will reject knowledge if it is presented in an interesting form, and especially if the acquisition of the same knowledge increases their wages. Skilled men who now are the backbone of the trade are getting older and their time for retirement is approaching, yet but few skilled workers are coming forward to fill their places. Many molders today work more or less as automatons, doing the daily job just for the few dollars received as wages at the end of the week. Such a molder does not know what bearing chemistry has on his product or the materials he handles. More often than not he does not know that chemistry has anything to do with it, and he does not care. If he does know that the chemist pokes his nose into his job his reaction many times is to deride him as a kind of useless disfigurement in the order of regular business.

Promote Co-operation

The foundry demands intelligent men, men with a good sound general knowledge of what is going on, so that a willing and intelligent cooperation may result. Most foundry workers need enlightenment. The trade is suffering from a lack of competent workmen, of efficient managers, of a thorough system of apprentice training. Apprentices should be taught more than merely manipulative skill. They should be trained to think their job from the raw material to the finished product. To know one small part of the process does not breed interest and initiative. The human mind is inquisitive and acquisitive, for who will reject knowledge or learning if he can get it in an interesting and acceptable form? Every manufacturer should teach his quota of apprentices, and teach them along well organized lines.

The writer is convinced that it is essential to give a simple course of chemistry as applied to the foundry. It is just as important to give a practical knowledge of the operation of the cupola, both of which could be done at little expense and with profit to the foundry in general.

It is not advocated that every foundry apprentice should be made into an analytical chemist, nor suggested or expected that the average apprentice should be able to make an analysis of pig iron, coke, coal, lime or scrap, or any other substance used in the foundry. However, the writer would demonstrate how this is done, and why it is needed. This would widen the apprentice's interest in his work, and in some instances would induce him to go further. It would brighten his intelligence, increase his efficiency and give him a real insight into what he is doing. The course should be along the lines of quantitative analysis, finding the percentage of silicon, manganese, phosphorus, carbon and sulphur, etc., explaining at the same time what effect these elements have on iron.

Some such simple course would do much to improve the standard of foundry workers and the product of the foundry because it would create interest.

The writer further would recommend as introduction to this instruction that a short discourse on iron, its occurrence in nature, indicating on a map the location of ore beds, how smelted, with a brief description of apparatus, the qualities of pig obtained, common impurities and reason for same, and why the foundryman should be careful in his selection of different grades of pig. Some advice naturally should follow on the effect which these grades have on the resulting cast iron after remelting in the cupola. The appearance of fractures with explanation and the uncertainty of judging by fracture. The value of analysis as the best guide.

Leading up to the foundry chemistry a brief description should be offered in simplest language of common terms and symbols used in chemistry, particularly applicable to the foundry. Also a brief description of the various metals and elements and compounds which enter into every day conversation of the up-to-date foundryman and the effect that these have on iron castings, and the advantage and use of the common and necessary instruments used in the foundry should be touched upon. Other points which could be covered with advantage are as follows:

The composition of cast iron and why certain mixtures are made.

The author is apprentice supervisor, Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.

The results of too much heat, too little heat.

The effect of too high a pressure or too much volume and the reverse in cupola operation.

Melting points and colors.

Contraction, shrinkage and expansion, temperature and melting points.

What is meant by analysis and how analyses are made.

Explanation of acids and alkalis and their effects.

All this would be handled in class room work, but the cupola practice should be demonstrated in a practical manner in the foundry.

A small simple laboratory could be equipped and there an instructor could demonstrate to a few apprentices at a time the actual operations of an analysis explaining step by step what the object is and showing the result. Where an apprentice shows ability and aptitude he may be used with advantage in working out the analysis.

There would be no intention to go into chemistry beyond the actual requirements of the foundry. For example, the analyses should include iron (pig and cast iron) for carbon, silicon, manganese, phosphorus, sulphur content; and of fuel for sulphur; of fluxes for silicon, lime, etc. It is not the intention to go deeply into these matters.

It is not easy to say just where such instruction will finish or how much the average foundry apprentice will absorb. The foundry industry demands a practical knowledge of chemistry. All those who decide to take this forward step in the training of foundry apprentices must be prepared to have difficulties and it will require tenacity of purpose to put it through.

The other important feature mentioned in the training of foundry apprentices is a simple but practical demonstration of the uses and operation of the cupola. At small expense a small but otherwise practical operating cupola can be made from scrap material. The shell may be made from a piece of old steel tube about 30 inches in diameter and 9 feet long. This should be lined with firebrick for the first 3 feet of its length, arrangements being made for tuyeres, tapping and cleaning holes. It may be set on a pier of brickwork about 12 inches high if made with a solid bottom. A suitable stack is fitted to the top. The blast pipe may be made from 4-inch stove pipe and bends. A belt driven blower may be arranged for variable speed to give 4 to 6 ounce pressure, or failing this air can be taken from the main blower line through a reducing valve, and an expansion main.

Other details suggest themselves. The inside diameter would be about 18 inches and the melting capacity about 500 pounds of metal per hour.

This cupola could be used to demonstrate to the apprentices what may be expected from the full size cupola. The demonstration should take the form of a complete cycle of operations. The demonstration plant should be near, but set apart from the foundry.

Make Course Short

The writer has prepared a brief, concise course of instruction to give to the apprentice. This presents a continuous sequence of events and operations in making an iron casting from the ore to the finished casting including the requisite knowledge of chemistry to produce the desired quality and composition. It is more a narrative than a textbook. Experience has shown that the average textbook is too formidable, too deep, and there is too much digging to get at bare facts. Authorities who have written on this subject are incomparably farther advanced in both practice and theory than the writer, but they have a different viewpoint. They hope to produce experts. My hope is to give a plain bit of practical knowledge to the workers that they may be able to work more intelligently and in harmony with the experts.

If the simple work inspires or encourages some apprentice or foundry worker to become an expert so much the better, but industry want intelligent informed workers as well as experts. One expert can direct the operations of a thousand workers, but the actual results depend on the quality of the latter, their intelligence, their knowledge and their cooperation.

If the writer was asked to recommend a simple chemistry course for foundry apprentices, correspondence schools provide excellent texts that may be supplemented by laboratory work, but without demonstration headway will be limited.

Such training as outlined, combining manipulative skill with practical demonstration of the technical side will have a strong tendency to induce high grade youths to want to learn the trade, and when applied will produce thoroughly trained foundry workers.

Brass Foundry Tests Every Heat

(*Concluded from Page* 6)

and the lead upon the anode. When deposition is complete, the cathode and anode are removed from the solution, washed with water and alcohol, dried and weighed. Difference in weight of the cathode gives the amount of copper which is deposited as metallic copper. Lead is deposited as lead peroxide and the metallic lead is determined by calculation. Zinc, tin, iron and phosphorus are determined by the pyrophosphate method, oxide method, colorometric method and by the molybdate method respectively.

The laboratory also contains apparatus for determining the physical properties of nonferrous materials. A 100,000-pound testing machine made by the Riehle Testing Machine Co., Philadelphia, is used for determining the compressive and tensile strengths. Hardness testing devices manufactured by the Olsen Testing Machine Co., Philadelphia, and the Wilson-Maulein Co., New York, are used for hardness determinations.

Two home-made devices are used in determining drill hardness and wearing quality. The first consists of a drill press with an attachment which applies a definite weight to the spindle containing the drill. The drill is operated for a certain definite time on samples and a comparison made of the depth of the hole drilled during the period. The wear quality machine which is used principally on bearing metals consists of a revolving friction axle or drum against which the specimens bear with a definite pressure. The amount of wear is determined by the comparison of bearing area before and after the test is completed.

Issue Transactions

The 1927 *Transactions* of American Foundrymen's association which will be Volume XXXV, is being printed and should be ready for distribution in December. This volume will contain reports, papers and discussions presented at the Chicago meeting and will be another valuable addition to the library of volumes on foundry practice which the A. F. A. has made available to foundrymen. One copy will be sent free to each member. Honorary members may secure copies through the office of the secretary, 140 S. Dearborn Street, Chicago, for $6.00 net. Members may obtain additional copies at $4.80 each.

Cupola Melting of Steel *Affected by Coke Properties*

By James T. MacKenzie

STEEL scrap in cupola mixtures has challenged the attention of foundrymen for a number of years. Many papers have been presented in the technical press and before the various technical societies dealing with the strength of irons obtained from such mixtures, and it is accepted almost universally that steel scrap does increase the strength of the iron quite out of proportion to its effect on the chemical analysis. The recent work of Piwowarski on the influence of graphite nuclei has given a valuable theory as a basis for future investigation and may assist in the interpretation of some heretofore anomalous results. Accurate thermal data may be expected in the foundry literature of the future, because the development of the optical pyrometer has placed within the reach of everyone the means of observing and recording temperature.

Recent investigation has shown that the disappearing filament type of pyrometer is accurate, within small limits, for all types of foundry irons. Quickness with which readings may be made, even by an inexperienced observer, is remarkable. Many of the conflicting results obtained by the use of steel scrap are due undoubtedly to differences in melting conditions, of which the temperature is probably the most important. *Hot iron* is an indefinite term and may mean one thing when spoken by the stoveplate founder and something entirely different when spoken by the manufacturer of heavy castings.

JAMES T. MacKENZIE, author of this article which was presented at the Sheffield conference of the Institute of British Foundrymen on behalf of the American Foundrymen's association, is chief chemist, American Cast Iron Pipe Co., Birmingham, Ala. Mr. MacKenzie has contributed numerous articles on ferrous metallurgy to the technical press and especially has investigated the effect of phosphorus on iron.

Another cause of misunderstanding in discussions of steel has been the confusion of test bar and casting. The iron that will make the strongest test bar of say 1.25 inches diameter and 15 inches in length certainly will make a poor radiator, if it will make it at all, and will be almost as unsuitable for a heavy casting. This is one of the reasons we see various statements as to the maximum permissible percentage of steel scrap in the charge, which, if memory does not fail, varies from zero to 100 per cent.

Inextricably associated with the temperature of melting and the chemical composition of the melt, is the problem of oxidation. With steel in the mixture, the lower the melting temperature, the greater the oxidation, the lower will be the carbon, silicon, and manganese, and the higher will be the freezing point and the gas content. Consequently the practical fluidity, or coulabilite as Guillet and Portevin call it, rapidly is reduced.

This paper is concerned chiefly with the total carbon absorbed by steel scrap when melted with the various cokes of an unusual collection, not complete, but well representative and

Table I

Presents Information on Coke

Coke	Oven	Ash	Volatile	S.	Porosity	Shatter	Sp. Gr.	Carbon in melt	Appearance of coke
Dayton	Bee Hive	17.0	0.4	1.7	59	70	1.94	1.73	Dull gray, overburned.
Sewanee	Bee Hive	16.9	0.7	0.6	....	80	.... ..	1.80	Silver bright.
Fire Creek	Bee Hive	5.8	0.6	0.5	59	93	1.94	2.10	Dull, light gray.
Bradford	Bee Hive	3.9	0.5	0.5	50	50	1.80	2.81	Silver bright.
A. B. C.	By product	10.0	0.7	0.6	46	68	1.92	2.50	Dull, dark gray.
A. B. C.	Unbroken	.....	....	.....	....	....	.....	2.17	Dull, dark gray.
Barrett	Bee Hive	1.1*	0.9	0.4	47	88	1.85	3.38	Dull black.
Bayonne	Unknown	0.1	5.0	1.2	....	75	.....	3.54	Dull black.
Parco	Still residue	0.2	15.0	0.5	....	55	.....	4.27	Shiny black.
Wichita Falls	Still residue	0.3	14.0	1.4	51	52	1.92	No melt	Dull black.
Shell	Still residue	1.4	18.0	1.4	....	....	.....	No melt	Dull black, badly broken.

*Largely dust from long storage—the new coke runs about 0.4 per cent ash. This extraneous excess would not affect the properties of the coke.

Carbons calculated to basis of 2.00 per cent Si, 0.10 per cent P, and 0.50 per cent Mn.

Shatter is amount remaining on 2 in. screen after four drops from 6 feet.

Porosity (or cell space) determined according to A. S. T. M. standard method.

containing the extremes likely to be encountered. The cupola used was manufactured by the Whiting Corp., Harvey, Ill., with a 27-inch shell, lined to 18 inches with clay brick, with 2 tuyeres 17 inches above the mantle plate and 70 inches below the charging door. The lining was straight from mantle to charging door. The tuyeres measured 9 x 3 inches at the lining; and the blast, supplied by a fan, was fairly constant at 4 ounces per square inch. In some of the early heats the volume increased as the stock fell in the stack, but the practice was changed as soon as this was noted and thereafter the stack was kept full of coke throughout the melting period. None of the heats reported here was affected by this to a great extent, though in several heats a slight drop in carbon on the last tap or so may be noted. The cupola was lighted in the usual way and the wood allowed to burn away by natural draft. Coke was added to have the bed at 30 inches above the tuyeres when the bed properly was burned through.

Wind was then put on for five minutes to heat the tap hole and basin, after which the bed was built to 40 inches with fresh coke, the breast stopped in, the charges quickly put in and the blast put on as soon as the stack was filled (about 5 minutes). The first tap was made in 25 minutes, when usually 25 to 75 pounds of iron were obtained, after which melting proceeded at the rate of approximately 1000 pounds per hour. A shank ladle of 200 pounds

Table II

Detailed Data of Tests Performed

Coke	Date	Bar.	C.	Si.	P.	Mn.	S.	carbon	load	Defl.
Dayton	3/27/24	124	1.72	2.02	0.09	0.94	0.228	1.70	4,780	0.36
		125	1.70	1.76	0.07	1.08	0.184	1.63	5,000	0.35
	4/30/25	219	2.04	1.13	0.16	0.36	0.192	1.86	4,300	0.28
		220	1.96	0.88	0.11	0.38	0.173	1.73	3,250	0.21
	5/4/25*	225	1.89	3.39	0.13	0.67	0.236	2.18	3,600	0.29
	(4/30/25)	226	1.99	3.42	0.13	0.42	0.254	2.29	4,230	0.34
Sewanee	5/5/25	227	1.96	1.88	0.13	1.04	0.105	1.91	5,100	0.34
		228	1.73	1.71	0.12	0.30	0.102	1.68	5,100	0.34
	5/8/25*	233	2.62	1.95	0.14	0.73	0.156	2.60	3,700	0.32
	(5/5/25)	234	2.56	1.86	0.14	0.37	0.155	2.53	3,000	0.22
Fire Creek	8/14/25	316	2.09	2.22	0.10	0.33	0.102	2.13	3,700	0.31
		317	2.18	1.45	0.10	0.45	0.098	2.06	4,600	0.28
Bradford	7/30/25	300	2.78	2.55	0.09	0.38	0.119	2.90	3,650	0.35
		301	2.75	1.89	0.05	0.29	0.107	2.73	3,680	0.33
	8/1/25*	304	3.45	1.71	0.12	0.33	0.140	3.39	3,180	0.40
	(7/30/25)	305	3.25	2.04	0.11	0.34	0.134	3.26	3,000	0.35
A. B. C.	3/19/24	113	2.48	2.94	0.05	1.52	0.111	2.64	3,090	0.28
		114	2.74	2.05	0.05	1.24	0.121	2.72	4,570	0.41
	5/1/25	221	2.34	1.64	0.11	0.40	0.126	2.26	3,800	0.26
		222	2.23	1.40	0.10	0.27	0.113	2.11	3,250	0.21
	5/6/25*	229	2.85	2.46	0.12	0.51	0.173	2.95	3,500	0.34
	(5/1/25)	230	2.85	2.30	0.14	0.67	0.156	2.90	3,600	0.37
	7/17/25	288	1.45	0.04	6.46	0.26	0.161	2.80	1,050	0.09
	(20% Fe_3P)	289	1.81	0.04	4.80	0.24	0.124	2.70	920	0.07
	7/20/25	292	1.91	4.35	0.08	0.50	0.140	2.35	3,500	0.32
	(20% Fe_2Si)	293	2.15	3.60	0.15	0.48	0.132	2.49	3,300	0.30
		294	1.98	3.51	0.15	0.49	0.131	2.30	3,200	0.27
A. B. C. Bed	7/21/25	295	2.58	2.22	0.11	0.29	0.160	2.63	3,450	0.37
With 40% Barrett Above	(10% Fe_2Si)	296	2.65	1.75	0.16	0.28	0.149	2.61	3,400	0.37
(Steel from Shell Coke Experiment)	8/5/25	308	2.50	2.83	0.06	0.27	0.188	2.68	3,450	0.29
		309	2.72	0.69	0.08	0.20	0.154	2.44	3,000	0.21
A. B. C. 50 per cent	8/29/25	336	3.09	1.95	0.08	0.38	0.189	3.10	3,400	0.34
W. Falls, 50 per cent		337	3.21	0.80	0.12	0.26	0.192	2.97	3,060	0.22
A. B. C.	1/21/27	402	2.17	1.04	0.09	0.39	0.062†	1.97	3,690	0.27
Unbroken (Steel 3¼ inch Round)		403	2.12	1.52	0.11	0.47	0.077	2.02	4,290	0.27
		404	2.16	1.95	0.08	0.47	0.066	2.15	4,970	0.44
		405	2.26	1.00	0.12	0.25	0.070	2.16	3,360	0.25
(Steel, ¾ in. Round)	1/22/27	406	2.30	1.52	0.07	1.29	0.110	2.20	4,700	0.31
		407	2.30	1.50	0.06	0.29	0.122	2.20	4,200	0.29
		408	2.27	1.85	0.09	0.36	0.104	2.24	4,240	0.28
		409	2.52	0.95	0.05	0.41	0.102	2.30	4,100	0.28
		410	2.31	2.32	0.08	0.28	0.080	2.38	3,740	0.29
(Steel, ¼ in. to ¼ in. thick)	1/29/27	411	2.00	2.26	0.07	0.32	0.115	2.05	3,730	0.27
		412	2.14	2.14	0.08	0.28	0.118†	2.17	3,510	0.24
Barrett	3/13/24	107	3.37	2.25	0.02	0.61	0.092	3.42	3,200	0.46
		108	3.27	3.28	0.04	1.32	0.080	3.52	1,950	0.42
	3/31/24	129	3.47	1.20	0.18	0.52	0.266	3.30	3,120	0.39
		130	3.28	1.70	0.17	0.48	0.130	3.22	3,320	0.43
	4/2/24	131	3.11	1.96	0.89	0.40	0.119	3.32	3,660	0.34
	5/2/25	223	4.05	1.50	0.09	0.44	0.106	3.95	2,100	0.49
(Coke, 85 lbs.)		224	3.92	1.17	0.11	0.29	0.104	3.75	2,600	0.41
	5/7/25*	231	4.18	2.36	0.12	0.54	0.097	4.26	1,930	0.57
	(5/2/25)	332	4.09	2.70	0.12	0.38	0.095	4.23	1,750	0.51
Bayonne	6/11/25	240	3.75	1.36	0.05	0.61	0.122	3.62	2,600	0.36
		241	3.68	0.90	0.06	0.55	0.170	3.45	2,490	0.28
Parco	8/6/25	310	4.42	1.16	0.09	0.82	0.141	4.24	1,920	0.54
		311	4.33	1.70	0.10	0.66	0.125	4.27	1,700	0.46
W. Falls	6/11/25	No melt	.....	.....	.....	.....	.....	.....	.....	.....
Shell	8/4/25	No melt	.....	.....	.....	.....	.....	.....	.....	.....

*Remelts of heat in parentheses. †Evolution sulphurs on bars 402 to 412 inclusive. All others oxidation.

capacity was used for handling the molten iron which was poured into pigs on the first two or three taps and then into well blacked and dried test molds, giving the 2 x 1 x 28-inch bars cast vertically.

Charges were 100 pounds with sufficient 50 per cent ferrosilicon and 80 per cent ferromanganese to give the indicated composition. These were placed on top of the steel in the center of the cupola. The coke charge was kept constant at 25 pounds, except in the case of the high volatile petroleum cokes, Parco, Wichita Falls, and Shell. No fluxing was attempted, but there was usually a thin liquid slag which was allowed to run into the ladle and was skimmed off before pouring. The amount of this slag varied practically with the ash content of the coke. It seems that the higher the ash the greater the oxidation of the steel and the proportion of ferrous oxide to silicon dioxide is maintained automatically. There was little cutting of the lining except in the melts with the high-ash cokes.

Table I shows the results for total carbon which are calculated from the detailed data of Table II. The base was taken as 2.00 per cent silicon; 0.10 per cent phosphorus; and 0.50 per cent manganese. Pure iron holds 4.3 per cent carbon in solution; 80 per cent manganese, about 6.7 per cent carbon; and 21 per cent silicon (Fe_2Si), or 15.6 per cent phosphorus (Fe_3P), throw the carbon to zero. Therefore the corrections are as follows:

For each per cent variation in manmanese (3.4/80), 0.04 per cent carbon.
For each per cent variation in silicon (4.3/21), 0.21 per cent carbon.
For each per cent variation in phosphorus (4.3/15.6), 0.28 per cent carbon.

The calculations are admittedly doubtful, but the sum of all three corrections is less than 0.20 per cent in nearly all cases, and it seems the only hope of reducing all the melts to a common basis. Table II is given to enable anyone to make a detailed study of the actual results obtained undisturbed by the assumption of the author.

Turning again to Table I, it seems that in the beehive cokes the carbon rises as the ash falls, but in no regular way; while in the pure cokes the same thing is noted in regard to volatile matter. It is at once apparent that the structure of the coke is of fundamental importance and may counteract to a considerable extent the effect of the composition. The two high-ash cokes have little difference in structure and little in carbon absorption. The Bradford is much softer than the Fire Creek (which is extraordinarily hard and dense), and so carburizes to an extent not warranted by the difference in ash. Coming to the pure cokes, the Barrett is hard and dense (really a true coke), the Bayonne quite cellular, and the others highly cellular. In fact, the Wichita Falls burned along the cell walls so rapidly that small pieces were blown out of the stack in a veritable shower, which no doubt accounted for its failure to melt.

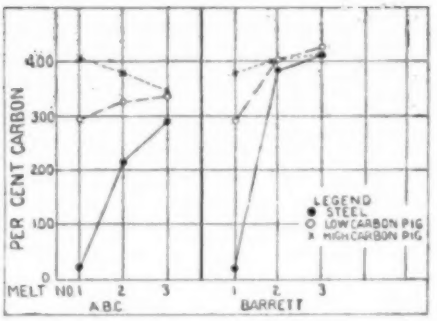


FIG. 1—SHOWING TENDENCY FOR ALL MATERIAL TO ATTAIN SAME CARBON CONTENT ON REPEATED MELTING. THIS POINT IS DEPENDENT ON COKE AND BLAST

The Parco was much better, and gave few sparks of this nature, but required an inordinately long time to begin melting, and then melted slowly. The furnace was 70 minutes in blast before any iron melted, and then it came slowly but hot, throwing out great quantities of "kish" as it was being poured. The Shell coke was so broken up in its long journey in bags from the Pacific Coast that it was almost useless to try it, but under the heat is melted down to a soft gummy mass, so no deductions could be made from its original structure. While it is not thought that the volatile matter has any influence *per se*, on escaping it probably leaves the coke in a more porous condition than originally.

Table III

Carbon on Remelt

Coke	Carbon 1st melt	Carbon 2nd melt	Carbon absorption, 2nd melt
Dayton	1.80	2.23•	0.43
Sewanee	1.80	2.57	0.77
Bradford	2.81	3.33	0.52
A B C	2.18†	2.93	0.75
Barrett	3.85	4.25	0.40

•Cold melt.
†Scaffolded.

In an able paper published by F. Hudson in *The Foundry Trade Journal*, Dec. 11, 1924, entitled "The Melting and Casting of High Duty Irons," the four points influencing the absorption of carbon are stated as follows: (1) Temperature in the melting zone; (2) time in the melting zone; (3) atmosphere of combustion; and (4) initial analysis of material melted. That these are true there is no doubt, for the first two and last are special statements of the fundamental laws of solution, viz., temperature, time of contact, and concentration. The third, based on the known chemistry of the iron-carbon-oxygen system, is fixed probably better in the minds of foundrymen than the other three. However, the author would question the restriction implied in the words *melting zone*, for he is convinced that absorption can and often does continue in the hearth following exactly the laws stated above. Running only 15 per cent steel on A. B. C. coke he has observed a constant difference in total carbon of 0.10 per cent when tapping intermittently as against continuous flow, the latter being about 3.50 per cent and the former 3.60 per cent; this on the large foundry cupolas running heats of 10 hours.

Restates Principles

Since only the melting of steel scrap is being considered, where the original material is nearly the same in all cases, these principles may be restated as: (1) Temperature; (2) time of contact *with carbon*; and (3) atmosphere of combustion. Looking at the problem solely from the standpoint of the coke, the case may be stated: That the temperature depends on the purity, reactivity and size of the coke in the melting zone and below; that the time of contact depends on the purity and size of the coke, for the higher the ash the more will be the tendency to cover up the carbon by slag and prevent contact with the metal; and that the atmosphere of combustion depends on the purity, reactivity, and size of the coke. Since the reactivity depends on the purity and physical structure, and since the effective size of the coke depends on the structure, one may assume that the extent of carburization depends on the purity and structure of the coke.

Unfortunately, the testing of coke has not reached the plane of true science, and, although it can be taken for granted that the reactivity is a function of structure, no one is yet sure of a test that will indicate the right structure for maximum reactivity. It would appear that for carburization, coke should not be either extemely dense or extremely porous; that it should be neither too hard nor too soft; and that it should be neither

heavy nor light. A hard, dense, heavy coke will tend to allow oxygen to persist a long distance above the tuyeres, and the molten metal will flow over a comparatively small surface of coke on its way through the melting zone, where most of the carburization takes place.

Just as rock candy is harder to dissolve than loaf sugar, so is the dense carbon more difficult to dissolve than the light, though time of contact is probably the explanation of both. On the other hand, a soft, porous, light coke will burn almost entirely to carbon monoxide close to the tuyeres, with consequently low temperature, and it will crush down easily and either shut off the blast or blow out of the stack as did the Wichita Falls. Undoubtedly, if high temperature can be obtained with a soft, pure coke, the metal can be saturated easily beyond the eutectic. A medium structure would appear in general to give the maximum corburization, even if temperature is sacrificed somewhat. Highest temperatures obtained were with the Fire Creek and Barrett cokes, but neither gives the best carburization for its class. By increasing the amount of Barrett to 35 pounds per charge, or the same ratio as the Parco heat of 5/2/25, carbons of nearly 4 per cent were obtained at temperatures approximating 1,600 degrees.

Contains More Carbon

This is not truly comparative, since 35 pounds of Parco coke contained only 30 pounds of carbon, and the Barrett contained almost 35 pounds, but the test is illuminating as an illustration of the effect of high temperature and greater time of contact using the same coke thus eliminating the effect of all other variables.

The melts with unbroken A. B. C. coke show clearly the effect of the coke size on the carbon absorption. For all other tests on this cupola, the coke was broken up carefully so that no piece remained on a 2-inch screen; but in these three tests large lumps of coke, none of which would pass a 2-inch screen, were used throughout and the carbon dropped 0.3 per cent, from the average for the broken coke in spite of the same temperature obtained under both conditions (1500 degrees Cent.)

The experiment with Wichita Falls and A. B. C., 50 per cent each, above a bed of A. B. C. is interesting, Table II—heat of 8/29/25. Here a corrected carbon of 3.04 per cent was obtained from the mixture, though the temperature given was rather low (1450 degrees Cent). Thus by mixing a coke (or probably pitch would be more accurate) of high reactivity with one of good structure, results may be obtained not possible with either alone.

As most of these melts were made on mild steel scrap of nondescript character and with a considerable variation in size from that desired (1-inch round), it appeared worth while to run some tests to see if ordinary variations in size had any effect on the carbon absorption. A 500 pound piece of 3¼-inch round mild steel (0.16 per cent carbon, 0.06 per cent phosphorus, 0.43 per cent manganese, and 0.038 per cent sulphur) was cut into 8-inch lengths and melted (heat of 1/21/27). The next day a similar test was run with ¾-inch round of the same analysis cut to 8 inches. The heat of 1/29/27 was run on thin strips of the same steel, varying in thickness from ⅛ to ¼-inch, and in width from 1 to 2 inches, as there was not sufficient of one particular size in stock to make up a complete melt. The large steel was heavier than anything used in these tests, and the thin strips were lighter than anything used in them, while the ¾-inch round almost would represent the average. It is evident that the carbon absorption does not depend on the size, for the average of the large bars and the thin strips is the same. For some reason the temperature of the ¾-inch round melt was fully 50 degrees higher than the other two, and the carbon is 15 points higher.

The author examined bars of the heat of 8/5/25 under the microscope, finding the merest film of carbon, so it was decided to melt it with A.B.C. coke as a further test on this point. The carbon on the melt, 2.56 per cent is just 0.06 per cent above the average for this coke on new steel, and is well below some other melts, so it is thought there is no doubt of the accuracy of the generalisation, which also was made by Hudson.

Table III shows the equalized carbons on five melts which were remelted with slight additions of silicon and manganese, using the same coke. The metal from the first melt was largely in pigs, and therefore considerably heavier in section than the steel. The average was approximately 2 x 3 x 8 inches with some few pieces as large as 4 x 4 inches. The original A. B. C. heat scaffolded after the second tap, because some of the rods were too long. So, it is not truly representative of the melts of this coke, but the remelt went off in great shape. The remelt on the Dayton coke was sluggish, probably due to oxidation and high sulphur, though the silicon was increased abnormally in anticipation of this result. It was difficult to get an accurate reading, but it was estimated that the temperature was about 1,400 degrees at the cupola, which is close to the liquidus for such a low carbon.

This set of tests is to be extended for a discussion of the equilibrium point of carbon in the cupola. For this, sufficient quantitative data are not yet available, but the author trusts they will be completed and published in the near future. There has been perhaps, sufficient work to show that each coke tends to produce a certain definite carbon content in the melt For a given coke this is affected by the elements other than carbon—particularly phosphorus, silicon, and manganese, and by the proportion of coke to iron and coke to blast. For the same iron and blast ratio, and the same iron composition, it will vary as the purity and structure of the coke.

Carbons Rise

On A. B. C. coke, the remelt of steel 0.2 per cent carbon reaches 2.93 per cent and the remelt of the 4.15 per cent pig shows 3.55 per cent carbon (first melt 3.78 per cent). The result from a synthetic pig of 2.95 per cent carbon (first melt 3.30 per cent) showed 3.46 per cent carbon. Undoubtedly if the steel had again been remelted, the carbon would have risen again. The above values are plotted in Fig. 1 with similar results for the Barrett coke. The diagrams clearly indicate equilibrium points of 3.55 per cent and 4.20 per cent carbon for these respective conditions. It is evident that under repeated melting the time of contact will cease to be of importance, as time equilibrium will be reached, and that the temperature and atmosphere of combustion will be the controlling factors. Aside from the effects of phosphorus, silicon, and manganese on the solubility of carbon in iron, all fairly well established, the equilibrium point for carbon will depend on the deoxidizing constituents of the melt—manganese, silicon, titanium, etc.; the oxygen, carbon dioxide, and carbon monoxide content of the gas; and the temperature of the whole system. As the temperature and composition of the gas phase depend on the purity and structure of the coke, the amount of the coke, and the velocity of the blast, it is hoped that suitable tests for coke can be devised whereby the equilibrium point for the particular coke can be predetermined with fair accuracy for any given set of conditions.

What Causes Dirty Castings?

Extended Experiments Showed That Agitation of Molten Iron Either by Air or Steam Throws Out Sulphur and Manganese in the Form of Excessive Slag

By W. F. Prince

PROBABLY 4 per cent of all castings ever made have been found defective. When we try to imagine what that represents in dollars —the first thought that comes is why haven't we given this question closer study.

We have had bad castings so long that they seem a part of our trade. As we look over our loss and find it around 4 per cent, we feel we are doing as well as the average. This 4 per cent does not define our losses properly. If one gives the subject careful study I believe he will find that the losses show on certain castings and from the same cause day after day. If the loss was computed by the amount made of a particular casting or castings, he would find the loss from 10 to 50 per cent. The remainder of castings on which the loss is little or none helps to bring down the average. When we look over the figures and see our loss showing from 2 to 4 per cent we feel satisfied. These same losses continue from day to day and year to year. A certain casting always gives trouble. It is apt to crack or warp, become dirty or shrinks, develop blows, scabs or may have other defects. The cause lies in the shape, design or condition under which this casting has to be made.

A certain casting may show a certain defect. The foreman looks at it. He forms his opinion of what caused the defect and in many cases instructs the molder how to overcome it. However, in the majority of cases, the foreman considers the trouble lies with the molder who made the casting and he will give the job to one he knows has had good success with it.

Have we not in the past counted too much on the skilled molder? Nearly every foundry has a few skilled molders who seem to have a faculty of turning out good castings. When troubles over castings show up, they are turned over to one of these men. Why?

He is one who realizes all the conditions that might cause trouble. Every stroke of his work is done according to his best judgment. He makes a study of all bad castings, forms his opinion and makes up his mind what to do. Nearly all bad castings are made by the molder who does not think or study his conditions. I believe we have not given the true cause of bad castings the study we should, but have counted too much on the assistance of the good molder to get us out of trouble. We have not made a proper study of the subject and put the results of our study into such shape that the average molder could take advantage of it and safeguard himself against trouble.

The majority of bad castings are rejected on account of dirty spots, blows, scabs, shrinks and cracks—yet some of the same lot show no defect. Why are some good and why are some bad? If some are good, why are they not all good?

Needs Expert Diagnosis

I always have considered the foundry business like a human being subject to many diseases. The best foundryman is like the best physician. The patient shows a defect. The physician who has made a study of special defects is better able to suggest a remedy than one who rarely comes in contact with them. A patient may have a sore caused by an unknown condition. We have wonderful schools today where physicians are taught how to locate obscure causes of defects and they find many strange causes—so with our bad castings. Some condition is wrong. A bad spot may be caused by some remote condition. The bad section is the outcrop or weak spot where the results of error creep out. Learned physicians sometimes disagree on a diagnosis and many competent foundrymen also may disagree, but the more learned we become, the more we study the cause and effect of different conditions, the sooner we become able to rectify our troubles.

The average foundryman jumps at conclusions without studying the principle. He is not a learned man and the average learned foundryman is not a practical man. I believe the question of bad castings will be solved better when the average foundryman becomes both learned and practical. The better practical molder of the past was the one who combined practice and study. In all things a good and a bad principle is involved. To overcome trouble, one must study that principle. My reason for stressing this feature is because a bad casting may be caused by so many different things.

In my work for the past 25 years I have had to contend with a daily output of from 100 to 300 tons of castings. Most of them had to undergo steam, water, gas, air or ammonia pressure and I have had my percentage of bad castings as well as other foundrymen. With such a large output of castings to meet severe specifications, it became necessary for me to make a constant study of bad castings. My opinion may not coincide with that of other foundry physicians but I am presenting what I considered some of the causes.

Consider a dirty casting, one showing slag on top also showing dirty areas when finished. What is this slag? What is the slag on top of the pig iron used? This on the castings is the same. What causes it? Agitation combining sulphur and manganese.

Before going into this subject to show why I think it is agitation I want to explain a process I patented once for the purpose of taking sulphur out of melted iron. A foundryman came to me one day with a section of a 60-inch pipe cast on end in a loam mold. It had been broken out of the pipe about two-thirds of the way up from the bottom and showed slag and dirt.

I was having the same trouble with surface condensers at the time and I told him it was dirty iron, his gating was not right, his melting was not right, his mixture was not right, his mold was not right, but this advice did not satisfy him nor did it satisfy me.

I drilled the sample through the bad section and found it extremely high in sulphur and manganese. I then drilled in the clean spot and found it fully 25 per cent lower in sulphur.

While speculating on why the sulphur had accumulated and lodged at this section the idea came to me that the metal had boiled in the loam mold either from the iron getting under the

bottom ring or because the mold was not dried thoroughly. Later in casting a condenser I watched the metal come up and saw this slag accumulate and roll to the outside wall of the mold. To test out a theory I bored an 1/8-inch hole in the bottom of a 2000-pound ladle and fitted a connection so I could turn on air pressure. The ladle was half filled with metal from the cupola and allowed to boil over the air jet for 5 minutes. An excessive amount of slag accumulated on top of the metal. This metal was cast into test bars and the analysis compared with that of metal as it came from the cupola, also the slag.

I cannot give the exact figures now but the iron after boiling showed a reduction of about 35 per cent in sulphur and the slag showed an excessive amount of sulphur. Hundreds of these tests showed that by forcing air into molten iron, a combination was formed between manganese and sulphur and both came to the top. The amount of sulphur accumulated depended a great deal on the amount of manganese in the mixture and the amount of air used. In all experiments from 10 to 40 per cent sulphur was removed and this always came off in a slag. From these experiments I came to the conclusion that slag or kish in the molds was caused by a similar disturbance. It was created by agitation. It rose to the surface of the metal and was carried to some location where it was held. With this basic principle in mind, I started to prevent all agitation possible.

At that time we were turning out approximately 200 steam cylinders a day, jacketed heads and sides and with a bore diameter from 10 to 84 inches. These cylinders had to be clean. They did not always come clean but conditions were improved wonderfully after the cause of the trouble was found. With sand conditions right, molds and cores baked and vented right, boiling or agitation of the metal stopped.

Tricks With Rods

Metal entering a cylinder mold, drops down into jackets, up and around cores and if it finds moisture or a section where gas cannot escape freely, this moisture and gas sets the metal into motion and the sulphur process is in action just the same as it was in the experimental ladle. The slag accumulates and drifts to some location where it is held. I believe this same condition is responsible for every casting that shows such a defect. Even a washer mold if wet or hard enough to cause the slightest disturbance of the metal will show the effects on the surface of the casting.

Many old molders will recall how we had to stand watching on a cylinder mold or a roll mold with a rod of iron, for this accumulation of slag, to keep it from lodging against the sides of the mold. I realize all agitation cannot be prevented but knowing that agitation does produce slag, it is apparent that reduction in agitation means a reduction in slag. A mold with 50 per cent of its liability to cause agitation removed will reduce liability of a bad casting 50 per cent.

My former article on rebonding of old sand was partly inspired by this condition. I always found the older the sand, the more water required to assist the bond and the more moisture, the greater proportion of danger in agitation.

Venting of molds should be given more consideration. How often you hear a foundryman say, "I never vent such and such a mold. I don't have to. I don't have any trouble." How many cores are made without vents and the same is said of them. "I don't have any castings blow on account of not venting." All this may be true but if the steam or gas does not pass away freely, the mold may not blow or show bad but the chances are that that metal went through that same sulphur process. Perhaps not enough to show or perhaps the slag drifted to a section where it would not be seen.

Defects Are Hidden

Many a person has gone into a contagious hospital and never contracted any of the diseases. Others do so at once. All depends on the condition of the subject. If every mold condition is healthy and good, danger of contagion is thrown off. The safest way is to keep out of the danger zone. Vent, dry and be careful to prevent agitation. To test this theory drill into the top of a slaggy pig and then drill into the bottom and note the difference in the sulphur content. Take the slag from the top of this pig, analyze it for sulphur and you will find the sulphur process has been at work.

Sulphur is more responsible than any other cause for bad castings. A low sulphur charcoal iron will give a clean ladle of melted iron and liability of a dirty casting has been reduced to the proportion of sulphur in the mixture. Metal low in sulphur going into a mold will stand far more agitating than a higher sulphur mixture. This is one of the reasons why charcoal iron was favored for cylinders. It was clean or we considered it so but the true cause was the low sulphur content.

Slag which accumulates on top of pig iron is an oxide and when melted in the cupola, does not all go back into the metallic form. I once chipped off 180 pounds of this slag and melted it in a crucible and found I could only recover about 30 per cent. or 54 pounds. I do not believe we ever reduce it back in our cupola practice. If it melts and runs as slag, and if we are fortunate enough to get it out of the cupola, we are rid of it, but all foundrymen know that more or less of it comes out the spout with the metal.

Loam Mold Plates

A loam molder accustomed to making loam plates and building rings in open sand will recognize the difference between the surface of plates made on an open bed well made and well vented and one that is hard or wet. How often after a section of plate starts to boil the molder runs a vent wire under that section and quickly stops the agitation.

Is machine cast pig as good as sand cast pig? In my opinion it is not. Machine cast pig boils more in casting, creates more oxide and deposits more oxides in the cupola which never go back into the metallic form. To prove this take a dirty top pig and plane off ½-inch all over the top and do the same with a clean top pig, then melt both sets of shavings in a crucible and note the result. What little slag shows up on top of a pig may not seem much but on a 50 or 100-ton melt going through the cupola it is a factor to be watched closely to see that it does not get into the molds and cause dirty castings.

Prepare Bibliography on Cast Iron

The American Foundrymen's association has had prepared, under direction of J. W. Bolton, Lunkenheimer Co., Cincinnati, a complete bibliography on cast iron. This has developed under auspices of the cast iron committee and now is available in preliminary mimeographed form.

The committee has brought together abstract references to all foreign and American articles on this subject printed since 1858. It includes approximately 1500 references. A limited number of preliminary mimeographed bibliographies are available at $5.00 per copy.

Rollway Bearing Co. Inc., Syracuse, N. Y., has opened a sales office at 614 Empire building, Pittsburgh, in charge of Samuel Farrell.

The FOUNDRY Family Photograph Album

Upper Left
W. J. CORBETT,
Steel Founders Society of America,
Pittsburgh

Lower Left
MICHAEL BURNS
Yonkers, N. Y.

Upper Right
L. J. BARTON
McGill, Nev.

Lower Right
C. A. BARNETT
Foundry Equipment Co.,
Cleveland

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

By O. W. Potter

(*Continued from Data Sheet No.* 692)

Volumetric Modulus of Elasticity (*Bulk Modulus*)

This is the modulus in a body with an equal stress in all directions. Two-thirds Young's modulus of elasticity (in tension) usually is considered as approximately correct.

Elastic Ratio

The ratio between elastic limit and ultimate strength. The approximate ratios are as follows:

Material	Tension, Per cent	Compression, Per cent
Wrought iron	45	45
Steel	65	65
Malleable iron	70	40
Cast iron	30	30-10

Patience

Time required for a substance to come to a state of rest after deformation. This is an important consideration in connection with forging, rolling, and the machining of metals and alloys.

This property must be considered in the producing of accurate stable dimensions in machining operations. Heat treatment is being used to aid in arriving at this state of perfect rest.

Hardness

Resistance to permanent deformation or abrasion. Different kinds of hardness are:

Cutting hardness.

Resistance to abrasion (scratch hardness).

The wear test for hardness is reported by Dr. Stanton as follows:

(a) Wear test for dry rolling (Samter Test).

(b) Wear test by sliding.

Resistance to indentation (brinell and rockwell). Static hardness is sometimes used when the force is applied slowly as in the brinell test.

Rebound hardness (scleroscope). Dynamic hardness is sometimes used when the force acts suddenly as in the scleroscope test.

Chemical hardness is hardness due to its chemical composition.

(*Continued on Data Sheet No.* 700)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 699)

Physical hardness is hardness due to chemical and physical structure.

Mechanical hardness is hardness due to working, principally cold working. This is also known as *work* hardness and *strain* hardness.

Hardness Values

	Brinell Hardness Number	Scleroscope Hardness Number
Pure iron	70	18
Wrought iron	118	24
Armco iron	75	18
Soft steel	107	18–25
Alloy steel	100	18–50
(Heat treated)	200–600	40–80
Malleable iron	101–145	15–20
Cast iron	143–217	30–45

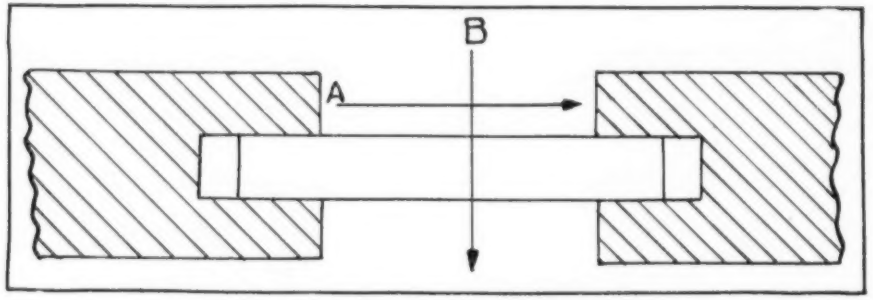


FIG. 1—SHOWS PLANES OF ACTION IN DETERMINING POISSON'S RATIO

Poisson's Ratio

Ratio of unit lateral linear change in dimension to the unit linear change in length when under stress is called Poisson's Ratio.

Mild steel	0.27
Gray cast iron	0.32

The ratio of the reduction in unit linear dimensions along the vertical plane of *B* to the unit linear elongation horizontally along *A* is Poisson's ratio. It is always less than one-half and is always measured below the elastic limit of the material.

(*Continued on Data Sheet No.* 701)

How and Why in Brass Founding

By Charles Vickers

Titanium Uses Limited

We have a number of questions to ask as follows:—What use is made of titanium in the brass foundry. How is it used and in what form, and is it possible to use it in mixtures containing from 20 to 50 per cent lead? What is a suitable agent for a bearing metal containing 24 per cent lead; 4 per cent tin, and 70 per cent copper. How should it be used?

What is the best way to use sulphur galena or other fluxes in high lead bearing metals, and how and when and in what quantities should it be introduced. Should it be used in a first melting of the metal for pouring into ingots, and again when the ingots are melted for castings?

Titanium is used only to a limited extent in brass foundry practice for reasons well known to those familiar with the properties and applications of this element. As a consequence there has been no noteworthy development of rich nonferrous titanium alloys suitable for brass foundry service. As the alloy of titanium with copper cannot be made by carbon reduction of its oxide in the presence of copper, aluminum has to be used. Therefore, when the element is reduced from its compounds either in the electric furnace, or by the thermit process, the resulting alloy will contain a generous percentage of aluminum, which in itself would operate to limit the use of the element in nonferrous alloys, even if its effects were good. It has no value for leaded alloys, as it will not *hold in* the lead or give hardness to the mixture. This fact has been determined by experimental work.

Any highly leaded alloy can be hardened by the addition of tin, which is the best way, by the use of antimony to a limited extent, and by the addition of phosphorus. However, the latter is likely to *throw down* the lead, especially when the alloy is made by simple melting and mixing methods. The addition of nickel to such a mixture also is helpful.

Galena is lead sulphide (PbS) and contains 86.6 per cent lead. It is the chief ore of lead and is likely also to contain silver. It sometimes is used in making leaded alloys to prevent segregation of the lead, which it does by carrying sulphur into the metals. When such alloys can be made without sulphur they are all the better. We are unable to see how the method of adding the galena can effect the result, but it is possible some users have the idea that it does. It can be added to the molten copper before the lead and tin additions, or to the cold charge of copper, or after the lead has been alloyed. Sulphur also can be added directly in place of the galena. Other fluxes notably the sulphates also are used to retain the lead in solid solution. There are various methods of *processing* the lead that have the same result. However, the main requirement, is heat and plenty of it. Simple melting operations usually fail to produce good homogenous alloys when the lead is high. The flux, whatever may be used, has to be added on the first melt and on all subsequent melts.

Requires Smooth Finish

We are making small aluminum castings containing cores 3 inches long and about 2 inches diameter. We want a smooth finish inside the castings but do not seem to be able to get the right kind of a core. We have tried flour sand but it makes too rough a surface. Also the cores are difficult to remove from the castings.

Undoubtedly local sands will have to be used because of the cost of shipping such material from a distance. If anyone in the foundry is familiar with Providence river sand, and can match it nearly with a local sand, that is the sand should be used. Core oil is a good bond since the sand is sharp.

Ordinary sharp sand will make too rough a casting and it will be necessary to mix molding sand with it. A suitable mixture might be made by mixing thoroughly 2 pints of powdered rosin and 1 pint of flour. Mix equal parts of sharp sand and molding sand and to every 30 pints, add one pint of the flour-rosin mixture. Spray the cores with molasses water and bake in an oven hot enough to melt the rosin thoroughly. Such cores should make holes smooth enough without having to give them a wash. However, the finer the sharp sand available the less molding sand that should be mixed with it. A fine sharp sand such as previously mentioned requires no molding sand. It should be bonded with just enough oil to give a core that will stand handling but will not stand much rough usage, otherwise it will be too hard and the castings will crack.

Copper Should Be Low

We are making cooking utensils using No. 12 aluminum alloy. When the vessels come into contact with hot grease they discolor. Could this be prevented by a change in mixture? Also is there a liquid that will remove the discoloration by immersion as the articles are irrgular. What is the composition of No. 12 aluminum alloy?

The blackened grease can be removed by dipping in gasoline, but care must be taken not to set fire to the latter. The castings also may be swished around in boiling hot suds made with laundry soap being at the same time scrubbed with long handled brushes having metal bristles. The purer the aluminum, the better it is adapted for cooking utensils. Number 12 aluminum alloy contains 8 per cent of copper; 92 per cent of commercial aluminum. When it is brought ready mixed it may have been made from scrap and contain as a consequence zinc and other metals which cause it to discolor more easily than it should. We suggest that some commercially pure ingot aluminum be procured and some new alloy be made and tested in the castings to discover whether or not it blackens. Some makers of cast utensils use an alloy containing 4 per cent of copper only. In making these alloys, first prepare a *rich* alloy of 50 per cent copper; 50 per cent aluminum, by melting any amount of copper in a crucible and then adding a similar weight of aluminum and pouring into ingots. The *rich* alloy is melted together with the requisite amount of ingot aluminum to make the alloy desired.

The 4 per cent alloy may be made by adding 8 pounds of the rich alloy to 92 pounds of aluminum.

STEPS UP PRODUCTION

with Mechanical Equipment

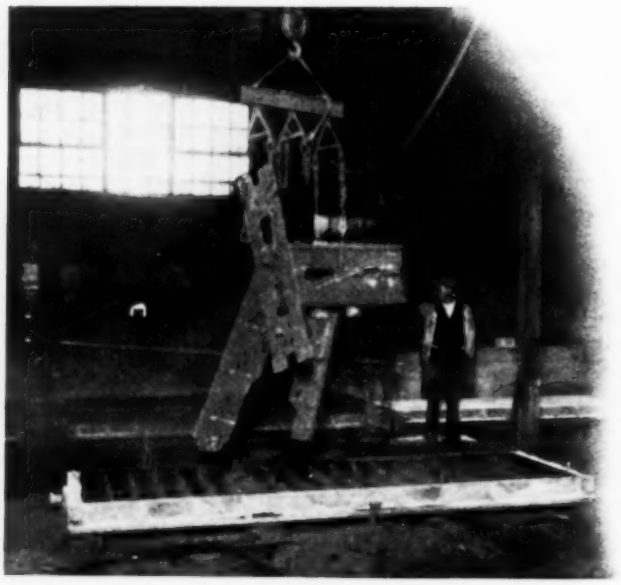


Fig. 7—Molds from the Conveyors Are Handled at the Central Shakeout

OPERATION of two exceptionally large power mold conveyor units in the plant of the American Abrasive Metals Co., Irvington, N. J., was described in detail in Dec. 15 issue of THE FOUNDRY. Briefly the molds are made on a roller molding machine, are carried to the conveyor where the abrasive material is applied, and the molds are closed and poured. As they are carried around the conveyor from the pouring station, the castings cool sufficiently to avoid the danger of warpage at the shakeout.

When the molds containing the castings reach the shakeout, shown in Fig. 7, they are shunted to the shakeout platform by an overhead trolley hoist. Rails extend from the conveyor platform to the edge of the shakeout. This feature increases the ease with which the large molds are handled, since it is necessary for the hoist to carry only a part of the weight of the mold and casting, the remainder of the weight being supported by the skids.

The shakeout consists of a grid supported at each end by an air operated jolt cylinder. Each cylinder has separate controls. When the jolt cylinders are operated the sand from both the cope and the drag falls through the shakeout grid on to underground conveyors which carry it to the sand preparing plant. The operation of the sand handling and preparing equipment will be described later.

The cope flask is picked up by a crane and carried to the gravity conveyors for distribution on the molding floor. A plan view showing the location of the shakeout, the conveyors and the sand equipment was included in the first portion of the description which appeared in the Dec. 15 issue. The castings, which are left exposed on the bars of the drag flask after the cope is removed, are picked up by another crane equipped with a multiple hook, as shown in Fig. 7. This equipment makes it possible for the

Fig. 8—Castings Are Given a Preliminary Cleaning with Brushes and Sent to the Sandblast Room

crane to pick up eight or more castings in one operation and with a minimum of effort. The crane is designed for rapid travel and carries the castings quickly to the preliminary cleaning station. The shakeout crew consists of three men who handle all of the molds and castings poured on the two power conveyors as well as those poured on the gravity conveyors and later transferred to the power unit by a pneumatic hoist.

When the castings arrive at the cleaning room, they are unloaded from the crane hook bail, as shown in Fig. 8 and the sprues are knocked off. The sprues are thrown into an industrial car, shown at the left in the illustration. When the car is full, it is pushed a short distance, through a door and into the yard where the yard crane equipped with an electric magnet picks up the sprues and carries them to the charging floor of the cupolas. Castings are brushed hurriedly with wire brushes to remove the greater portion of the sand which still adheres after the jolting at the shakeout station. After the preliminary cleaning, the castings, which still are rather hot, are loaded on cars operated on narrow gage rails, as shown in the background of Fig. 8. The castings are transported to the sandblast room on these flat cars.

The sandblast room is of the usual type. The castings enter at one side of the sandblast room, and after they are cleaned, are removed through a door at the other side of the room. However, the company contemplates a change in the cleaning methods. Most of the castings are flat and lend themselves to a continuous wire brush cleaning operation. Equipment for this method of cleaning may be installed later.

After the castings leave the sandblast room they are taken to the grinding and straightening department. The method of straightening is of considerable interest since many foundries feel that warped, thin gray iron castings are past reclaiming. Of course the American Abrasive Metals Co. takes every precaution to prevent bending of the castings. However, at times when pouring is not accomplished until the mold is beyond the station allotted for that operation, the time for cooling is decreased and the castings reach the shakeout too hot to resist bending.

Warped castings are straightened quickly and efficiently with a simple device which consists of an ordinary air hammer equipped with a blunt chisel and mounted over a section of standard tee rail. The device and the method of straightening the casting are illustrated clearly in Fig. 10.

One end of the casting to be straightened is placed over the rail, and under the crossbar. This position permits the operator to apply a considerable leverage over the rail. The casting is placed over the rail with the concave side up and as pressure is applied at the free end, the hammer is operated back and forth immediately above the rail. This peening action relieves the strains by changing the grain structure sufficiently to allow the metal to give slightly under pressure. With this method, castings four inches out of true in a distance of five feet may be straightened successfully. Most of the castings that are warped are straightened by running the air hammer across the face of the casting at two or three points. An experienced operator will handle from 50 to 60 pieces an hour on the straightening device.

Complete equipment handles the sand from the shakeout, through the preparing unit to the molding floor. Sand from the shakeout falls on an apron conveyor composed of continuous interlocking steel pans 36 inches wide. This conveyor, which is driven through gear reduction, carries the sand approximately 14 feet and deposits it on a belt conveyor which

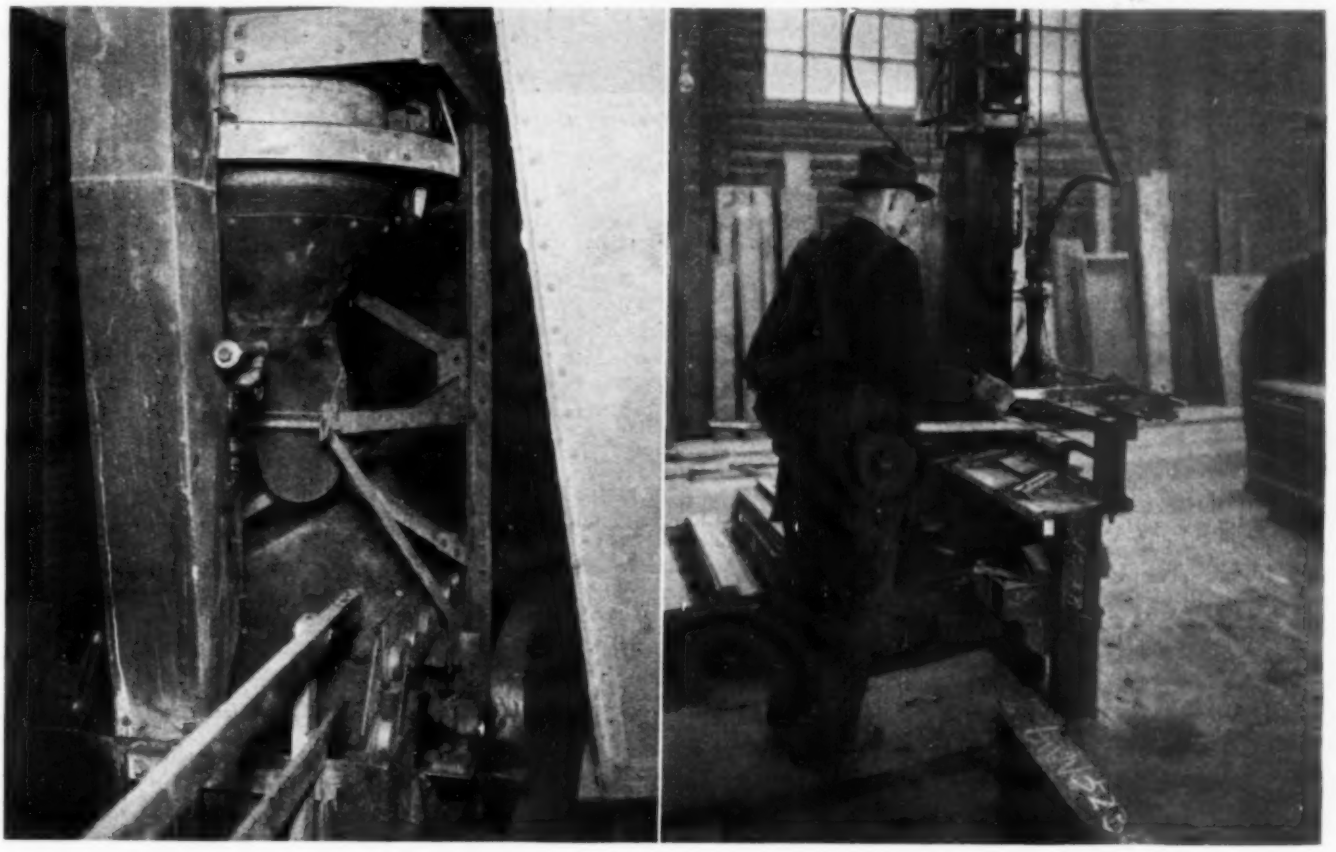


Fig. 9 (Left)—Sand Is Carried from the Storage Bins to the Mill on an Apron Conveyor. Fig. 10 (Right)—A Special Device Is Used to Straighten Bent Castings

Fig. 11—Patterns Are Made Up on Special Tables and Taken to the Molding Floor

is 38 feet long. A magnetic pulley is the supporting pulley at the discharge end of the conveyor.

The belt conveyor carries the sand to an elevator which in turn delivers it to a rotary screen. The screen is 6 feet long and is of a tapered hexagonal shape, 36 inches in diameter at the small end and 48 inches at the large end. The sand passes through the screen to a bin for used sand located immediately below the screen. The bin has a capacity of 60 tons. Sand falls through an opening in the bottom of the bin upon an apron conveyor. This conveyor, which is constructed of continuous interlocking steel pans 36 inches wide, is shown in Fig. 9. The apron conveyor carries the sand from the storage bin to the mill.

The sand used in the plant is a mixture of used molding sand and a synthetic molding mixture made up of spent sandblast sand and bond. Bond is added to the used molding sand on the conveyor from the circular tank shown in Fig. 9. The valve, which controls the water added to the sand mixture, is shown in the illustration. The used sand, bond and sandblast sand falls from the end of the apron conveyor into a rotary sand treating mill, where the water is added and a continuous mulling action takes place.

The mill consists essentially of a large circular steel plate shell slightly tilted from the horizontal. A casting is fitted at each end of the steel shell, the one at the receiving end having openings to receive the incoming mixture while the one at the opposite end is provided with openings for discharging the conditioned mixture. The mill has ring castings mounted on the outside of the shell which rest on rollers. The mixing or mulling action is produced by a number of loose round bars, inside of the shell each about two feet shorter than the shell. The sands and bonding material, in measured amounts, are fed into the receiving end and are distributed uniformly along the length of the mill. The sand together with the bars rotate with the mill. The mixer prepares sand and delivers it at the discharge end at 40 to 50 tons per hour.

Prepared sand leaving the treating mill is carried by an elevator to a long overhead flight distributing system. The flight conveyor carries the sand along the molding floor to the sand bins over the molding machines. A foot walk for the attendant has been constructed along one side of the flight conveyor. Castings made by the American Abrasive Metals Co. are used in this footwalk.

The pattern department of the foundry, which consists of a large floor space at one end of the foundry building, has many features of interest. This department has the general appearance of a drafting room. It contains approximately 20 large tables equipped with rollers and each table has a soft pine top. The pine boards are mounted on carefully machined iron bases. One cope and one drag pattern board are made on each of the tables. Standard pattern parts for the various castings are mounted on the pine boards with small brads. The gates are arranged properly on the cope board. The position of all parts is calculated from two metal base pieces which run at right angles through the pine boards. The tables are mounted on wheels so that they may be moved to the molding floor readily when the pattern is com-

(*Concluded on Page* 41)

Report of Bad Castings — Cast of **Nov. 25. 1927.**

MACHINE		PIECES CAST	PIECES BAD	REMARKS
Roller	No. 1	629	25	7 poor grit · 9 swells · 2 flows · 3 thin nosings · 5 run out
	2			
	3	846	29	11 poor grit · 5 swells · 4 flows · 2 crushed nosings · 1 crushed flange · 3 run out · 1 broken · 2 missing
	4			
	5	9	1	crushed nosing
	6	11	0	
Bumper	No. 1	32	0	
	2	54	2	1 drop · 1 missing
	3			
Floor	No. 1			
	2			
	3			
Grinding Pit		1	0	
Brake Shoes		71	2	blows
Coal Hole Covers				
Rabble Blades				
Bronzalun		32	0	
Alumalun		5	0	
Plumbalun		20	0	

Metal	Melt	Good	Bad
Iron	87000	57302	1686
Bronze	3500	2304	-
Alum.	120	55	-
Lead	650	365	-
Total	91270	60226	1686

Moulding ..... 9 hours
Pouring ..... 8¾ "
#1 conveyor .... 6 chargers
#2 " .... 7 "

Form 231 1-25 1000 — J. W. H. — Foreman — A. H. M. — Superintendent

Fig. 12—Daily Reports Show Rejects, Which Frequently Are 2 Per Cent Or Less

Goes 100 Days Without an Accident

The Safety Committee Gathered in Front of the Plant and the Bulletin Board Used To Record Progress of Safety Drives

EMPLOYES of the Union Steel Casting Co., Pittsburgh, on Dec. 2 celebrated the successful completion of a campaign for 100 days without a lost time accident with a safety rally at the plant. Safety drives have been a continuous proposition at that plant during the past year. Starting with November, 1926, which annually is designated as no accident month by the Western Pennsylvania division of the National Safety council, the men succeeded in making some fine records and also made February, April and June no accident months.

On Aug. 22 they started on the last and most successful attempt, the campaign for 100 no accident days, which was completed on Nov. 30, coincident with the November no accident drive. With a slogan of "No More Accidents for 1927", the men attending the rally planned for another record.

Speaking at the rally, J. A. Ortel, former president of the Western Pennsylvania Safety council paid tribute to the men and the fine record established. He pointed out that the biggest asset in life is an uninjured body, whole and entire, and stressed the necessity of goggles.

Safety work at the plant is in charge of D. J. Evans, superintendent, assisted by K. C. Wickline safety engineer, and a safety committee consisting of all department foremen and their assistants, together with the officers of the employes beneficial association. Meetings are held monthly to discuss and eliminate hazards which have been called to the attention of the members. Through their efforts they have effected a reduction in time lost on account of accidents during 1926 of 98 per cent from the 1926 record, the men having lost only 70 days on account of 7 accidents in the first 11 months.

The work of the safety committee is augmented by a 12-page mimeographed magazine which is given to all employes and which contains, in addition to full accounts of safety committee meetings, educational articles along safety lines and personal mention of the men about the plant. Posters are used effectively in connection with the drives, both of the home-made variety and those furnished through the National Safety council.

When it is considered that jobbing steel foundries generally are classed as extra hazardous, the full effectiveness of this safety record can be better appreciated. The plant at the present time employs about 400 men, although when operating at normal capacity, about 650 are employed.

Valley Brass & Bronze Co., New Kensington, Pa., has established a Pittsburgh sales office in the Oliver building, in charge of T. J. Llewellyn.

To Hold Conference

A second foundry conference will be held in the laboratories of the department of mining and metallurgy, University of Wisconsin, Madison, Wis., on Jan. 31, Feb. 1, 2 and 3. Following the plan of the conference held last winter, the round table method of presenting the subject matter will be used. A group leader will present the subject matter and lead the discussion in each group. In addition laboratory tests, demonstrations and exhibits will be arranged in the various laboratories of the university. Visits to foundries in Madison and vicinity will be arranged. Among the group leaders will be R. A. McPherran, Allis-Chalmers Mfg. Co., Milwaukee; G. W. Zabel, Fairbanks, Morse & Co., Beloit, Wis.; H. W. Dietert, U. S. Radiator Corp., Detroit; V. E. Hillman, Crompton & Knowles Loom Works; C. I. Wesley, Wesley Steel Treating Co.; A. E. Murphy, W. S. Ford & Co.; J. B. Handley, Whitehead Bros. Co., Rochester, N. Y.; W. J. MacNeill, Federal Malleable Co., West Allis, Wis.; P. C. DeBruyne, Moline Malleable Iron Co., Moline, Ill.; A. T. Baumer, Milwaukee Steel Foundry Co., Milwaukee; J. C. Schweitzer, Sivyer Steel Casting Co., Milwaukee.

Bill Gives Advice on a Split Steel Wheel

By Pat Dwyer

BILL came over to spend a quiet hour Christmas day and incidentally to show me a letter from a one time boon companion of the open road. This lad has been located for many years on a farm near a little town down East and occasionally he drops the pitchfork to take his trusty pen in hand. He never was what you might call a skillful performer with a pen, but he could handle a rammer or shovel with rare skill and proficiency. Bill never has forgiven him for deserting the ancient and honorable art of founding for what he claims is a life of drudgery on a farm.

"The funny part of it is," said Bill, "he knew nothing of farming. If he had been born and brought up among pigs and cows and chickens, with red mud sticking to his feet and with hayseed in his hair, with freckles on his face and hands, and a hump on his back from planting potatoes, I should not have been surprised at his return to his former condition of servitude.

"He was a city boy, born and brought up in Providence where he served his time in Builders' Iron Foundry. A skilled lad in sand and loam who had been on the road for a couple of years when I met him first in Milwaukee. We quit there together and bummed around for nearly two years in an easy-going itinerary which took us first to the Coast and thence by easy stages back East to Newark, N. J. We played a short engagement there at Maher & Flockhart's and then listened to the voice of a short dark complexioned gent who was recruiting a gang of molders to open a new foundry at a point so far east on this well known continent of North America that we were credibly informed the inhabitants pry the sun up in the morning with a crowbar.

"He met a girl down there, nothing extraordinary about that, he was meeting them everywhere, but this was one too many. The unfortunate creature cut loose from the gang, bought himself a new suit and spent his evenings holding the lady's hand in one of his big calloused paws, eating ice cream and otherwise bringing the molder's trade into disrepute, while the remainder of the gang was valiantly upholding the best traditions of the service at Pete Burke's, emptying the foaming flagons, dancing and singing and then taking the town apart on the way to their boarding houses.

"I wasted precious hours arguing with him, attempting to show him the error of his ways. I tried every honorable means to keep him where he belonged. I tied knots in his clothes and on one occasion shoved a small loaded blacking bag in one of his pockets. He did not appreciate these delicate and well meant attentions. In fact the day after the blacking bag episode he announced to all and sundry that if he only was sure of the identity of the bird who was so free with the company's blacking he would be delighted to split him with a shovel from the top of his head to the patch on the back of his pants. He was getting right peevish.

WHEN ONE STOUT FELLA MEETS ANOTHER

"I have been through the mill myself since that time and can see some excuse for his pitiable condition, but just then I was foot loose and fancy free and therefore in a position to see clearly the fate which awaited him. I entreated him to quit with me while the going was good and the box cars not too closely guarded. I tried to get into a scrap with him so that both of us would be fired. He was the most stubborn creature. He neither would fight nor run. Ain't love wonderful? Finally, I gave up the unequal struggle in despair and shortly afterward he married the girl and went to live on her father's farm near the town.

"He continued to work in the foundry for a few months and then the father died and left the farm to his only daughter. What did our hero do?"

"I don't know," I said. "Probably persuaded the girl to sell the farm, move to town where she could keep boarders and walk up and down the main street in the glow of the bright lights Saturday night." "No" said Bill. "You are wrong—as usual. That Yahoo's mind had become so contaminated from poking around the farm in his spare time that he actually threw up a good job in the foundry, publicly announced that side door Pullman tourists were nothing but a bunch of bums and that he was through with them. Then he settled down as a farmer and he is there yet. Several years ago when I was down that way he told me one of his sons had evinced a desire to leave the farm and learn the molding trade. The sterling ex-hobo had told him that if he caught him going near a foundry he would break him off at the hip pockets. A sad case any way you want to look

at it! Kind of a total loss.

"I had a letter from him the other day filled with references to cows and pigs and other smelly details of farm life from which it is apparent that his fall is permanent and that in all probability he never will recover. However, some of the items are rather interesting and show that his mind occasionally rises above his dismal surroundings. Listen.

Deer Bill: hey where do you get this here now high hat stuff sneerin about Barbara Allen. I seen the time you used to sing it yourself and I gess you thot it was pretty swell. Last week I wus in town one day tuesday or wensday no I guess it was the day after I wus mendin the fence in the back lot them first 2 days well any way I wus in town to sell a pig you know the long leg fella I told you I called after you—

"Say" Bill exclaimed "wouldn't that put a crimp in you? Wait until I write that lad. I'll call him a few things he never saw in the farm dictionary."

"The pig may have been all right" I remarked "besides you do have long legs. Push on."

"I'd like to push him one in the eye" Bill growled. "Where did I leave off? He rambles along without a stop, stay or punctuation mark like—I was going to say like one of his own potato bugs. A man would need a log line and a compass to follow this lad's course. Let's see 'a pig called'—I'll call that bimbo good and plenty—'called after you!' " an after I wus through I meets up wit slim McGonigle hes the asistint pusher in the shop now and he asts me down to his house. Slim figgers old iron jaw will pass out one of these days bust a blood vesil of somethin an then he will fall into the job. He aint no kid himself any more his legs is bent like a pare of calipers an hes all worped out of shape from standin too close to the sally mandirs on cold days. Course taint none of my bisnis an I didnt say nothin to him but I dont think he will ever step into old iron jaws shoos. Nothin ever will kill that old devil.

"This friend of mine" Bill explained parenthically "got a bawling out from the gaffer one day over a casting he lost through no fault of his and apparently he has never forgotten it. That's what comes of staying too long in one place, vegetating. A man nurses a grievance real or imaginary until it spreads all through his system and he becomes as sour as the bottom pickle in a barrel. By shifting around from place to place he acquires new interests and forgets all about it. I worked for old iron jaw and felt the lash of his blistering old tongue on more than one occasion, but I hold nothing against him. I remember one time —"

"I have heard about him before" I said. "If you met him tomorrow you would do your best to twist him into the shape of his favorite instument, a corkscrew. Never mind the crocodile tears and the sermon. What else has this agricultural friend of your's to say?"

"Plenty" said Bill "Plenty. The only trouble with him is that he takes so long to say it. It is bad enough in the original, but if you keep on with your silly interruptions I'll never finish it. Pipe down for a minute until I see if I can find a land mark to make a fresh start in the tangle. 'Twas some place here near the middle

FROM OLD TIME POPULAR SONGS: "WELL, BOYS, WHAT'LL YEZ HAVE?"

of the page. Ah! here it is, a touching reference to the old devil."

In preparation for the big job Slim reads all the foundry dope he can get his skinny paws on. He gets a paper called the foundry I ain't kidden you and hes got a stack of them now would fill one of them there slag pots shorty used to make in the pit down near the door. Say lissen do you know what shorty is doin now so help me he is selin biskits travelin all over the country takin orders for a bakery firm well he ot to no somethin about em he spent enough time sojerin around the oven when he wus on the loom job ha ha.

"Ha Ha! " said Bill sourly. "That's the poor prune's idea of a joke. It just goes to show how a man's mind will deteriorate when he forsakes the company of his fellows and spends his days rooting up the ground and talking to himself."

"If you don't snap out of it," I said "I know another lad who will be talking to himself. The jolly old bonds of friendship and all that kind of thing can be stretched just so far. *Alioop!* and so forth. On your way. Step on the gas, give 'er the steam, pull the plug, hump yourself. In a word, if you take my meaning, get going and stick to the straight and narrow."

"Straight and narrow what?" Bill inquired. "There is nothing straight and narrow about this thing. If I was not familiar with the hand writing I could not read it at all. The old boy's stance is good and his heart is in the right place but he lacks control. He shoots the long ones in the rough and his putting is deplorable, his score card is an abomination, but he gets there just the same."

"I'd hate to follow him around" I said. "Where is he now? Lost in one of the sand traps?"

"Stand by" said Bill. "Ladies and gentlemen we are now approaching the eighteenth hole."

"Make it the nineteenth," I suggested. "You might make better time."

"If the gallery kindly will keep its comments to itself" said Bill "its kindness will be greatly appreciated and we may get some place before dark. On account of listening to your everlasting chatter I have lost the ball. It is in here some place."

With the aid of a long fore finger he explored the page, poking around among the hyroglyphics until he found the place. Then he continued:

Slim shows me one of the foundaries wit a piece in it where you was speelin to pat dwyer about barbara Allen say is that the same bird what used to work on the dry dock in Farrels. I aint seen him in years the last I herd him and bo Lanigan wus in the old GE in Skenekadee. if its the same fella give him my best. Well Bill I sure was sprised the way you nocked that old song about Barbara allen I gess you must of forgot that night we had the smoker in the temperance hall an you stood on top of a beer keg an insisted on singing that very same song when you was called on by the chareman to do a stunt. I wont never forget that nite if I live to be a 100 wit Davy Bell tryin to dance a salers hornpipe an his legs playen triks wit him an old Jack mickfarlin weepin into his glass of beer and tellin everybody it wus de foist teday. I aint had a drink since Im off that stuff and I aint been to no smokers though the boys has been good enuf to ast me to come in wen they had em whats the use I figger I can get all the fun I want right here on the farm I got a bull caff that got a prize—.

"The remainder of the drivel" Bill explained as he folded the letter, "is a description of the daily grind which he is pleased to refer to as fun. Stumbling out of bed before daylight to spend about 18 hours a day waiting hand and foot on a bunch of pampered animals too lazy to even wash themselves. At the annual county fair he probably ties ribbons in the horse's tail, rubs cold cream and a dab of powder on the nose of his prize bull and manicures the pig's feet. I have seen the day when he hesitated to wash his own feet.

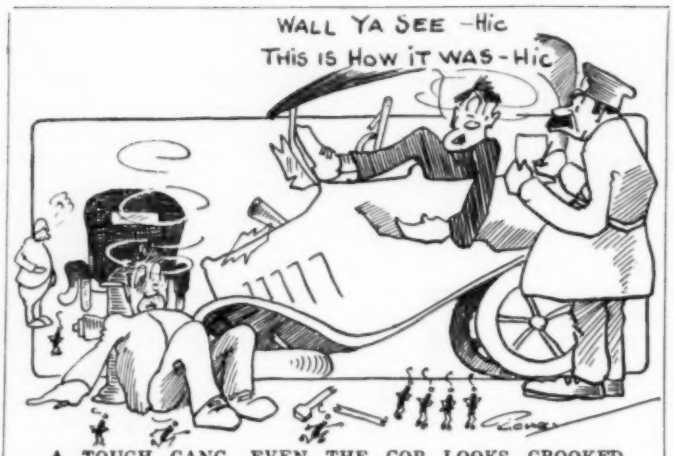
"Men, times and conditions seem to change every place except in the foundry. The row this lad I was telling you about had with the gaffer was over a half wheel. When the casting came out of the sand it was not a true half circle. It had *spread* to such an extent that it could not be machined to fit. The other day I had an inquiry from a man who was contemplating the same kind of a job and apparently he was doubtful of the outcome.

"He wrote that he had an order for a cast-steel pulley, 90 inches diameter, 13¾-inch face to be cast in two parts and afterward bolted together. He had been told that a casting of this kind does not shrink in the same proportion as other steel castings. If that was the case he wanted to know what is the proper shrinkage allowance to make in laying out the pattern.

"I wrote him standard shrinkage allowance for steel is ¼-inch to the foot and that proportion holds in every instance where the casting has the opportunity of contracting naturally. In certain instances, resistance set up by the mold or cores prevents this normal contraction. In other instances the design of the casting causes uneven contraction. The dimension in one direction will show less than the anticipated amount while a dimension taken in another direction will show that the anticipated contraction has been exceeded. A half wheel or any half circular casting always presents this characteristic in a marked degree unless proper preventative measures are taken in advance.

"To insure a perfectly round wheel and one in which the contraction will be uniform and according to standard allowance, it should be cast as a unit with splitting plates or splitting cores in the hub and at opposite sides of the rim. Suitable brackets cut at these places will prevent the casting from cracking during the contraction period and thus defeating the object sought, a one piece wheel. Assuming ¼-inch machining allowance on the face and on both edges of the rim, this metal also will assist in maintaining the shape of the wheel until it has cooled. The splitting plates or cores of course are designed to only cut part way through the hub and rim.

"Approximately 2 tons of steel would pour the wheel, assuming six standard arms and a rim 1½ x 15 inches, but if for any reason, lack of furnace capacity or molding equipment he is forced to cast the wheel in two separate halves, he will have to take extra precautions in making the molds, in melting and pouring the metal and even then it is extremely improbable that the two halves will match perfectly when the wheel is assembled. He probably will have to machine the rim inside as well as outside to secure a balanced wheel.



A TOUGH GANG, EVEN THE COP LOOKS CROOKED

"Claim that a half wheel does not contract in the same proportion as other steel castings is based on the well known fact that, in foundry language 'It pulls in the center and spreads at the ends.' Thus in extreme cases the diameter of the casting across the joint face is as great if not greater than the diameter of the pattern. At the same time a radial line taken from the center of the semicircle to the center of the hub will show there is not enough metal on the face to clean up. In other words the casting gives the general effect of a bent bow that has started to straighten out.

Use Tie Rods

"The usual method adopted to insure uniform contraction in a half wheel is to cast one or more tie rods across the straight side of the casting. In the present instance, I suggested two bars 1 x 3 inches, one near the top and the other near the bottom of the mold. These tie rods hold the end of the wheel rim in place and promote uniform contraction with the rim and arms. They are removed after the casting has cooled. If provision is made in the mold for free and easy contraction of the casting, the pattern may be laid out with a standard steel contraction rule, ¼-inch to the foot. A *total* diameter of 91¾ inches on the pattern will be reduced to 90 inches on the casting. That is only ⅞-inch contraction all around.

"In certain instances where a great many castings are required, a cut and try method is adopted with the pattern. The foundryman or patternmaker estimates the probable distortion at the extremities and bends the pattern in the opposite direction. Perhaps on the first trial he may hit the exact procedure to adopt. If he does not hit it the first time, he adjusts the pattern in the direction indicated as necessary by the first trial and tries again. Eventually the distorted pattern is employed regularly to produce true castings.

"Talking about tricky castings," said Bill reminiscently, "and the excuses hatched up by molders for losing them reminds me of the bunch of drunks whose car rammed another one at a crossing. 'Who was driving when you hit this car?' says the cop. 'None of us!' declared the pickled driver, triumphantly. 'We was all in the back seat!' "

Book Review

Atlas Metallographicus, by Prof. Heinrich Hanemann and Angelica Schrader, Parts 1 and 2, paper, 7¾ x 11 inches, 30 pages and 16 pages respectively, published by Gebruder Borntraeger, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $2 and $1.75 respectively and in London, 416-17 Caxton House, Westminster, for 10s and 8s 8d.

Metallurgists and others interested in the metallographic structure of iron and steel and who are able to read German will find this atlas of much value in studying the various structure formations. Part 1 begins with a description of the various formations such as ferrite, cementite and pearlite in carbon steel slowly cooled and annealed. The text also includes the iron-carbon diagram to explain the variations in structure which are reproduced in the illustrations. Following the text matter are eight tables and 64 micrographs. The tables give the data on the micrographs including magnification, etchant, analysis, etc., and with the plates containing the micrographs are in loose-leaf form so that they may be removed for mounting or placed adjacent to structures being studied.

Part 2 contains Tables 9 to 16 with their accompanying 57 micrographs. These also are in loose-leaf form, and show the structure of unalloyed, forged steels of various analyses.

J. M. Woods, formerly assistant sales manager, Semet-Solvay Co., Detroit, has been appointed sales manager of that company, succeeding J. A. Ballard.

Is Steel Capacity *Excessive?*

Comparison of Statistics Shows Marked Increase in Production of Steel Castings, but Percentage of Operation Indicates Idle Facilities

By W. J. Corbett

STEEL castings are manufactured in 293 individual plants in the United States and these are operated by 267 companies. The total practical capacity for the manufacture of steel castings in the United States is 198,863 net tons of good castings per month, or 2,386,356 net tons of good castings per year. Of this total capacity, approximately 9 per cent represents the steel foundry capacity of companies that manufacture steel castings exclusively for their own use as distinguished from those that sell their products to the consuming industries.

In addition, other companies operate steel foundries all of whose castings are not sold direct to consumers. Companies engaged in the manufacture of heavy machinery and also some of the large steel mills manufacture steel castings for their own use. However, the capacity of the steel foundries operated in this manner as separate departments of these large corporations, is sometimes greater than necessary for the manufacture of castings for their own use, and consequently the surplus foundry capacity is used to make steel castings sold in the open market in competition with foundries specializing only in the manufacture of steel castings.

The upward trend in the production of steel castings has been quite marked, since 1913 as shown in Fig. 1, and should continue in the future as more users of metal products recognize the strides that have been made in advancing the art of steel casting manufacture. The quality of the products made in cast steel has improved with consequent benefits to their users. While the accomplishments of the steel foundries have brought about increased recognition of the economy and usefulness of steel castings, and they should be more and more effectual in the future in increasing the consumption of these products, the capacity of the industry never has been utilized to its full extent. The increase in capacity has been greater than the increase in consumption of cast steel products.

The curves in Figs. 1, 3, 4, 5, 6 and 7 were constructed from data published annually by the American Iron and Steel institute. No data for the year 1927 are yet available, but it may be estimated that the total production of steel castings last year was below that in 1926. These diagrams show the history of the production of steel castings since 1910, and the trend is indicated by the straight line on each graph which has been determined in

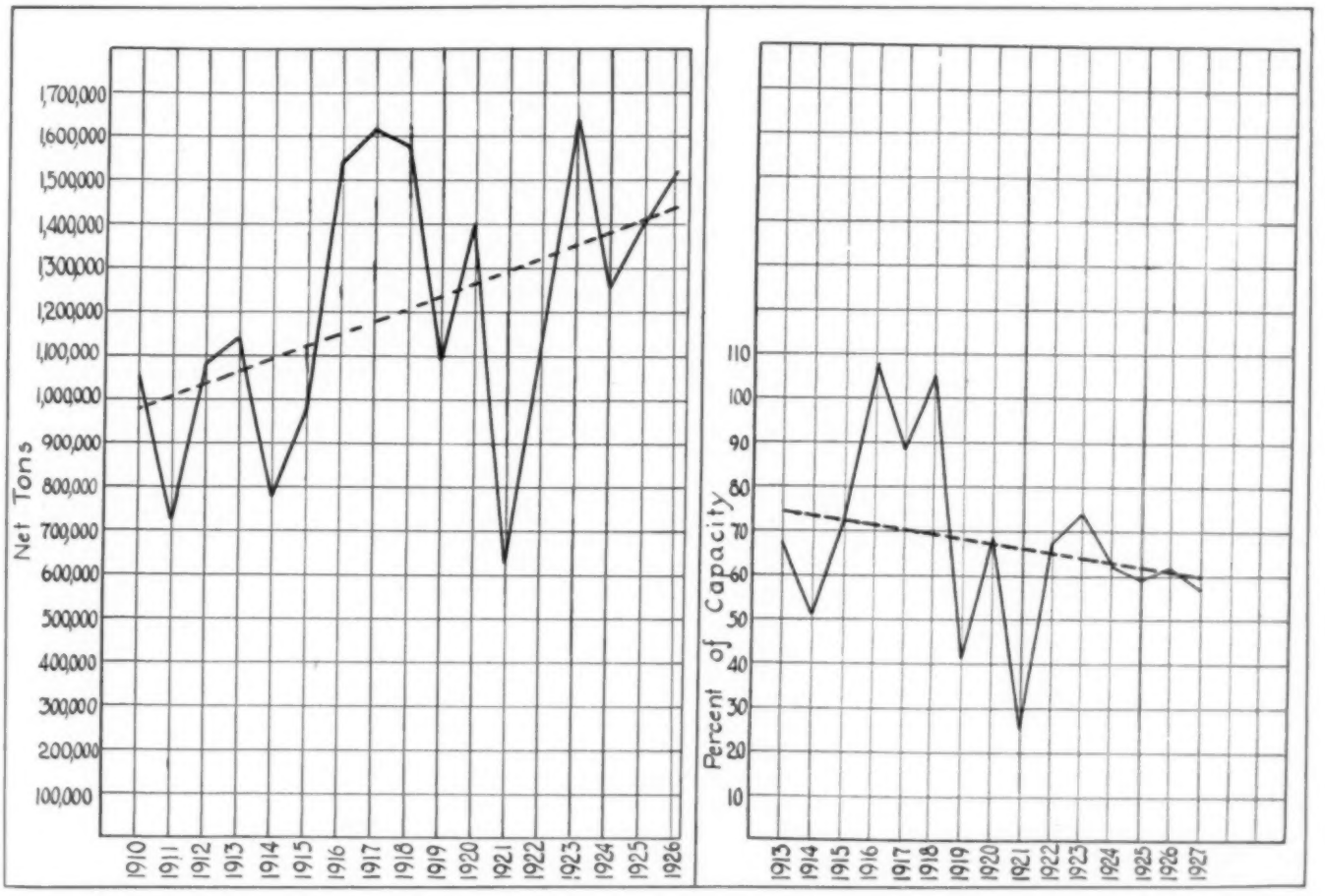


FIG. 1—THE TREND OF THE ANNUAL PRODUCTION OF STEEL CASTINGS HAS BEEN UPWARD SINCE 1910. FIG. 2—THE RELATION OF TOTAL BOOKINGS TO PLANT CAPACITY SHOWS A DOWNWARD SLANT

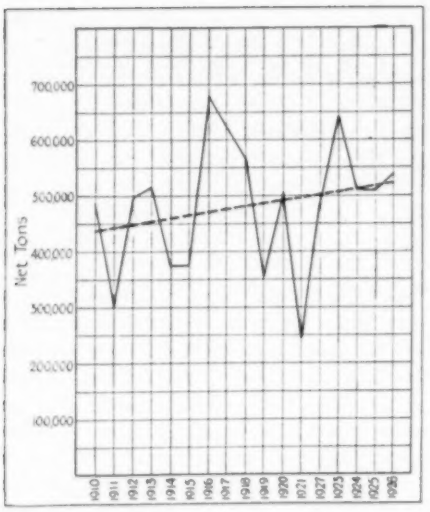


FIG. 3—ANNUAL PRODUCTION OF BASIC OPEN-HEARTH STEEL CASTINGS

accordance with the customary method of calculating the secular trend of a series of statistical data.

Fig. 1, showing the total annual production of steel castings in the United States, clearly indicates a marked increase in the use of steel castings. The average increase as shown by the straight line of secular trend is about 50 per cent since 1910, that is, one and one-half times as many tons of cast steel products were used last year as in 1910. This rate of increase in consumption of steel castings probably will continue due to the greater consideration that has been given during recent years and that will be given in the future to the merits of cast steel articles and to their sphere of usefulness in modern industry.

Capacity Pyramids

Despite the rapid growth in the consumption of steel castings as depicted in Fig. 1, the capacity of the steel casting industry has increased even more rapidly. Existing facilities for producing steel castings have been made more effective and this condition along with the new steel foundry capacity created during and since the war, has caused the total steel foundry capacity of the country to be much in excess of the total amount of steel castings the industries of the country consume. Therefore, further increase in steel foundry capacity would not be justified until such time as there is a decided increase in the consumption of cast steel products. If the total production of steel castings in 1927 was 1,320,000 net tons (estimated), only about 55 per cent of the capacity of the steel foundry industry was utilized.

Figs. 3 to 7 inclusive, are given to supplement Fig. 1, as they depict the output of steel castings according to the type of furnace used for making the steel. These diagrams are significant only insofar as they denote the general classes of steel castings produced, that is, the proportions of the total steel castings production shown in Fig. 1 that represent the output of foundries using the various types of steel making furnaces. They serve as guides in determining in a general way the amounts of the general classes of steel castings produced.

The trend of production of steel castings made in foundries using basic open hearth furnaces has been upward, as shown in Fig. 3. The output of these castings, as indicated by the line of secular trend on the diagram, is about 19 per cent greater at present than in 1910. During the past few years the consumption of steel castings made in foundries using basic, open-hearth furnaces, has been somewhat retarded by the retarded purchases of new railroad equipment. A considerable proportion of the total output of basic, open-hearth steel castings is used in the manufacture and maintenance of railroad cars.

The characteristics of Fig. 4, showing the annual production of steel castings made in foundries using acid, open-hearth furnaces, are similar to those of Fig. 3 for basic, open-hearth castings. The trend of production of acid, open-hearth steel castings is the same as that for basic, open-hearth steel castings. Here again the decreased purchases by the railroads has had considerable effect, since the production of locomotive castings and miscellaneous car castings is one of the important items in the output of acid, open-hearth steel castings. However, on the whole the products of foundries using acid open-hearth furnaces are considered general miscellaneous castings as distinguished from basic, open-hearth steel castings which largely are railroad specialty castings.

The output of steel castings made by the use of the other steel-making furnaces, shown in Figs. 5 to 7 inclusive, consists of small and medium size miscellaneous carbon and alloy steel castings. These types of furnaces are chiefly small units adapted for use in foundries manufacturing smaller castings than those ordinarily constituting the greatest proportion of the outgrowth of foundries using open-hearth furnaces. The field of usefulness of converters, crucibles, and electric furnaces in steel foundries lies in the manufacture of these small and medium size castings and of special alloy steel castings of limited weights.

Fig. 5 shows the gradual decline in the production of steel castings by the use of the converter. From a peak production of 180,000 net tons in 1918, there has been a decrease to 64,000 net tons in 1926. This decline is due entirely to the supplanting of converters by electric furnaces and small, open-hearth furnaces.

When conditions existed causing the

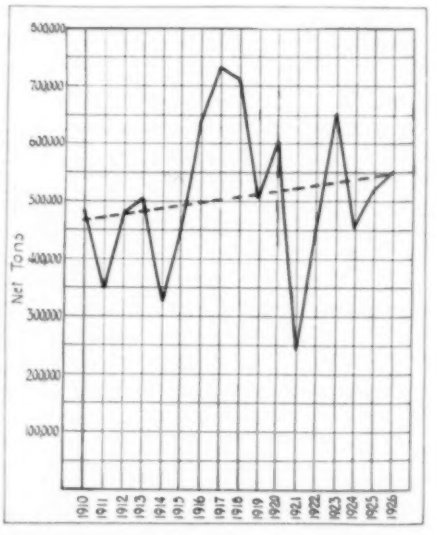


FIG. 4—ANNUAL PRODUCTION OF ACID OPEN-HEARTH STEEL CASTINGS

Qualified To Judge

WILLIAM J. CORBETT, the author of this statistical analysis of the steel castings branch of the foundry industry is secretary-manager of the Steel Founders' Society of America. Following his graduation from the Carnegie Institute of Technology, Pittsburgh, in 1914, *he entered the employ of the American Steel Foundries, where he served a special apprenticeship first at the Alliance works and later at Chester. He was advanced at the latter plant to the position of production engineer. During the war he served as ordnance inspector and in* 1918 *was made assistant superintendent of the foundry at Watertown arsenal. He returned to the American Steel Foundries as assistant to the fourth vice president in Chicago. From* 1921 *to* 1925 *he was cost accountant and industrial engineer for the Electric Steel Founders' Research group, terminating his connection with that organization to take on his present work with the Steel Founders' Society of America, Pittsburgh.*

cost of making steel in converters to be greater than the cost of making it in other types of furnaces, severe competition compelled steel foundries to displace their converters and install other types of equipment if there was a probability of reducing costs by so doing. This condition has not existed and does not exist in the case of all converter installations sinc it depends on economic factors.

Electrics Multiply

The production of steel castings by the use of crucibles for melting has had a rapid decrease as shown in Figure 6. The tonnage of steel castings made by this process during the last 17 years has been a small proportion of the total tonnage produced by the use of all steel-making processes. It now has become an almost negligible factor as indicated by the production in 1926 of about 2,000 net tons of crucible steel castings compared with a total production of 1,520,000 net tons of steel castings in the same year. Foundries using crucibles for melting steel are operated on a small scale and are limited in their production facilities.

A rapid increase in the production of steel castings by the use of electric furnaces for making steel, is shown in Fig. 7. The most significant increase took place at the beginning of the war, as the use of electric furnaces for making steel in foundries assumed important commercial aspects and prompted many new foundries to install them.

The output of steel castings from foundries operating electric furnaces has more than offset the decline in the output of converter steel castings and crucible steel castings, shown in Figs. 5 and 6. Much of the steel for castings formerly made in converters and crucibles now is made in electric furnaces, as the types of castings manufactured in foundries using the three methods of steel-making are in general the same, that is, small and medium size castings, and chiefly the former. The electric furnace has to some extent displaced the converter in steel foundries because of its economic advantage under certain conditions, meaning that when certain conditions exist in a certain locality at a certain time, the cost of making steel in an electric furnace might be less than its cost when the converter is used. However, when considering the factors that determine the relative costs of making steel, the important fact must be recognized that the cost of the steel in castings is relatively small compared with the total value of the castings and their total cost of production. The cost of steel in the castings ordinarily made in foundries using electric furnaces and converters is approximately 20 per cent of the total value of these castings and, therefore, differences in the cost of making steel in different types of furnaces exert only a minor influence on the total cost.

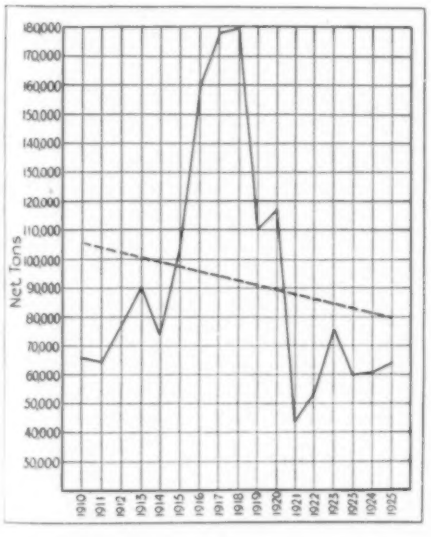


FIG. 5—CONVERTER CASTINGS REACHED A PEAK IN THE WAR PERIOD

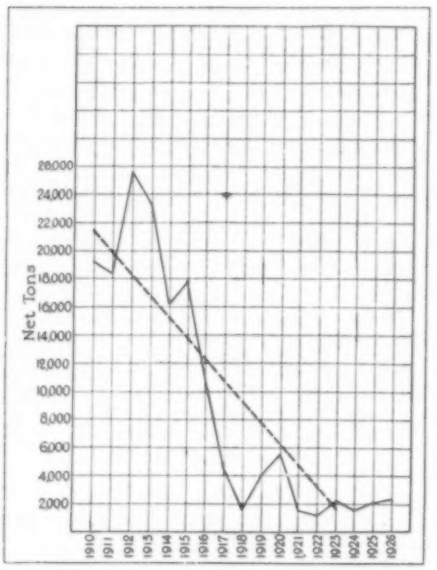


FIG. 6—CRUCIBLE AND MISCELLANEOUS GROUPS HAVE DECLINED

The rapid increase in the production of steel castings made in foundries using electric furnaces also has been due to the increased use of cast steel products by consuming industries. Products previously made of other materials and assemblies of materials have been converted into steel castings. Perhaps all of these new uses for steel castings have had a greater effect in augmenting the output of the smaller castings such as manufactured in foundries operating electric furnaces than they have had in the case of the larger castings made in open hearths.

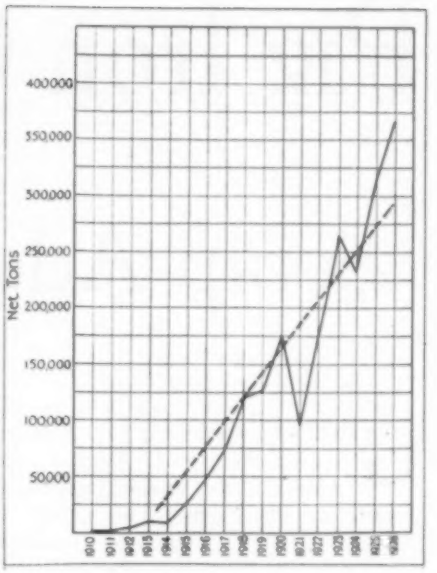


FIG. 7—ELECTRIC STEEL CASTINGS HAVE SHOWN A STEADY GAIN

It is probable that the increase in the output of castings made in foundries using electric furnaces may not continue at the same rate as indicated by the trend line in Fig. 7, unless new uses are created for these castings. The present number of electric furnaces in operation in steel foundries does not justify a further increase in the capacity of this branch of the industry. This is obvious when reference is made to Fig. 2, and the condition indicated therein applies to the entire steel casting industry. The rapid increase in number of electric furnaces put into operation may be largely responsible for much of the excess capacity.

Shows Over Capacity

The diagram in Fig. 2 is perhaps one of the most important of all those given. It shows the relation between the capacity of the steel casting industry to the demand for steel castings by the consuming industries. The statistics used for preparing this diagram were taken from the publications of the department of commerce.

During the period of the war a great demand for steel castings developed. This led to an increase of facilities for producing steel castings, and at no time since the war have these facilities reached more than 74 per cent utilization, according to the department of commerce.

Moreover, these production facilities have been increasing since that time and thereby causing the percentage of their utilization to gradually decrease, as shown by the

(*Concluded on Page* 39)

Pig Iron Quality Is Affected *by* Scrap Additions to Blast Furnace

By Jesse L. Jones

GROWING tendency of foundry organizations of Europe and America to present exchange papers at their general meetings is commendable for various reasons. Such a custom affords the opportunity of discussing live topics that are of mutual interest. By this means it may be possible to secure the co-operative action of a large number of investigators. Facts ascertained and given publicity in this way should aid materially in the satisfactory solution of important ferrous problems.

One such problem that deserves international attention is the utilization of the large volume of iron and steel scrap found in the world's markets today, so that the maximum of economy and the minimum of harm to the foundry industry will result.

Adding scrap to the blast furnace has probably been done in isolated cases for a long period. However, its commercial use seems to have developed in the past half-dozen years. The World war resulted in the accumulation of large stocks of iron and steel scrap, such as badly rusted sheet, barbed wire, etc. Near centers of automobile manufacture, large volumes of alloy steel turnings are produced and must be utilized.

Various phases of this subject recently have been published in a number of articles, some of which are indicated in the following list:

"Bad Castings and Furnace Scrap," by W. H. Hopkins, *Iron Age*, Nov. 5, 1925.

"Bad Castings and Scrap in the Blast Furnace Burden," by Dr. Richard Moldenke, *Iron Age*, Nov. 19, 1925.

"Bad Castings and Furnace Scrap," by R. C. Lundgren, *Iron Age*, Dec. 2, 1925.

"Scrap in Blast Furnace Burdens," by Dr. E. Bormann, *Stahl & Eisen*, Dec. 10, and 17, 1925.

The articles, with the exception of that of Dr. Richard Moldenke, presented the blast furnace viewpoint.

The meaning of the word *scrap* in the above connection will vary in different countries and at different periods. In the United States specifications for scrap for use in blast furnaces, as shown in Table I, were adopted under the auspices of the National Association of Purchasing Agents and the United States department of commerce at a meeting held in Washington, Feb. 4, 1926. These specifications became effective July 1, 1926. They also have been submitted to the American Engineering Standards committee for approval as tentative American standards.

The chief advantages of adding scrap to the blast furnaces are given by Dr. E. Bormann, as follows:

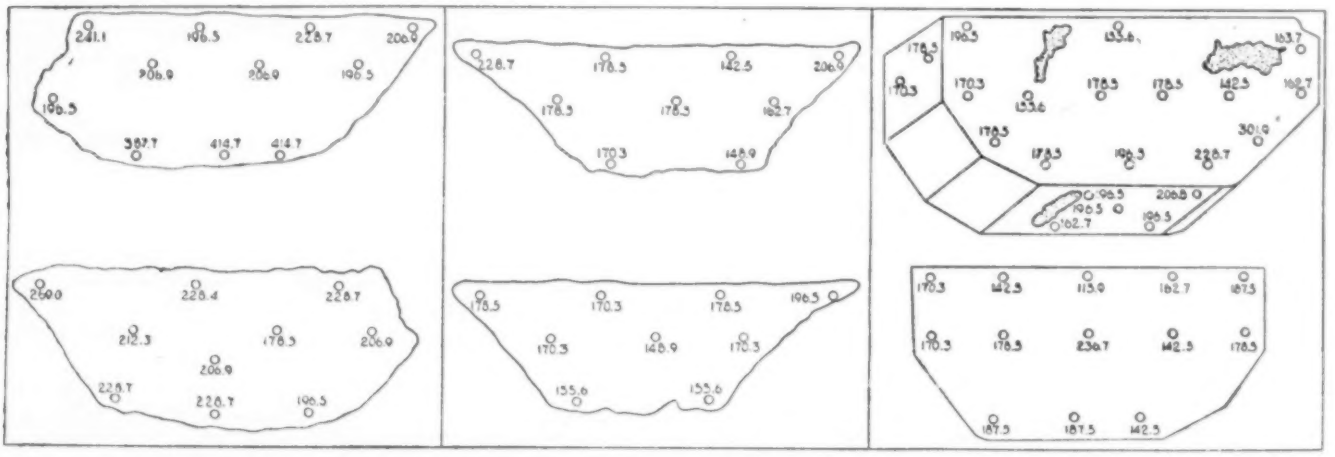
About 30 per cent less coke is used.
The output of pig iron is increased 60 per cent.
The waste gases have a greater fuel value.

More recently, credible reports in the United States state that in some cases after the maximum amount of scrap has been added to the blast furnace, the pig iron is tapped into large ladles; all the additional scrap added that will dissolve and the resulting metal poured into the molds of the pig machines.

A technical paper in commenting on this subject, said the United States was flooded with chrome and alloy steel scrap, this being especially true at centers of automobile production, like Detroit; that the alloy scrap spoils the runs from the furnace and cupola, and due to its mixture, there are a great many rejections and re-

Is Exchange Paper

THIS article is abstracted from the American Foundrymen's association exchange paper presented at the French Foundry Technical association meeting held in Paris, Sept. 7 to 10. The author is in charge of the chemical and experimental laboratory, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



FIGS. 1, 2 AND 3—CROSS SECTIONS OF PIG IRONS SHOWING THE LOCATION OF TEST INDENTATIONS AND GIVING THE BRINELL HARDNESS. FIG. 1 IS FURNACE 1, GRADE 3. FIG. 2 IS FURNACE 2, GRADE 1. FIG. 3 IS FURNACE 3, GRADE 2X

duction in prices, with difficulty in sales agreements.

More specifically, some of the troubles that may be expected from adding scrap to the blast furnace are:

Troubles due to alloy scrap.
Oxidation troubles.
Lack of uniformity.

Makers of malleable iron castings seem to be agreed that the presence of chromium is injurious to the quality of their product. It is said to give a *picture frame* structure that results in low tensile strength and elongation. As little as 0.02 per cent of chromium is said to be injurious, while 0.18 per cent will prevent proper annealing. Clauses in the specification for blast furnace scrap which make the presence of alloy steel scrap a matter of agreement between the buyer and seller, were inserted at the request of the makers of malleable iron castings.

Apparently it is desirable to segregate alloy steel scrap from other steel scrap. If this is not done, many metallurgists fear that the entire pig iron supply will become contaminated with chromium. This may work injury in other fields, such as the electrical sheet steel industry where appreciable amounts of chromium may affect injuriously the electrical characteristics.

The average iron foundryman is familiar with the hard, dirty sluggish metal that results from adding even moderate amounts of burned grate bars or other badly oxidized cast iron to his cupola mixture. It may be asked what harm can such material do in the blast furnace, as it is a function of the blast furnace to reduce iron oxide to metallic iron. This is true, but it is also true that there is quite a difference in the melting of oxidized or unoxidized pig iron in the blast furnace and the melting of the sponge iron resulting from the reduction of the ore. In the latter case, it is likely that every particle of the sponge iron as it passes the tuyeres of the furnace is surrounded by an envelop of slag that protects it from oxidation.

In the case of metallic cast iron, this slag envelop is missing and sluggish, oxidized pig iron is likely to result. In support of this view, Dr. Karl G. Lund, East Pittsburgh, Pa., informs me that he was stationed at a Swedish charcoal-iron blast furnace during the war. Pig iron for the manufacture of Lancashire wrought iron was being made and he noted that when more than 10 per cent of cast iron scrap was added to the blast furnace burden, the wrought iron was deficient in ductility and did not weld well. No research of the question was made, but the practical rule was observed of not adding more than 10 per cent of cast iron scrap to the blast furnace burden and the resulting Lancashire wrought iron was of good, commercial quality.

One of the gray iron foundries of the author's firm recently had trouble with drossy, sluggish iron. The addition of scrap to the blast furnace was suspected. However, in the absence of any history of the pig iron, it was worked up by using an extra amount of coke in the cupola and adding ferromanganese as a cleanser. This proved satisfactory, but it increased the cost of the castings made.

Lack of uniformity of composition and of physical characteristics are the most obvious defects to be expected in pig iron made under present conditions. The modern blast furnace has such a large capacity and has to be tapped so frequently that the iron is not in the crucible of the furnace long enough for thorough mixing. The use of scrap aggravates this condition. It was thought that the brinell test would show the lack of uniformity suspected in pig iron. Representative pigs (chill cast) were taken from about a dozen carloads of pig iron at two gray iron foundries. One-inch cross sections were machined from the middle portion of the pigs and brinell tests and analyses made. The pig iron came from four different blast furnaces in the Ohio district. The results obtained are shown in Tables II and III.

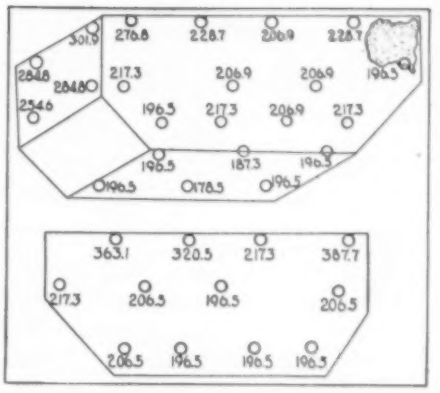


FIG. 4—BRINELL TESTS ON PIG IRON FROM FURNACE 4, GRADE 1

Figs. 1, 2, 3 and 4 show the location of the various brinell tests. The outlined areas on Figs. 3 and 4 indicate *kish* or graphite spots.

Whether this lack of uniformity in the hardness of chill pigs will persist when the pigs have been remelted in the cupola and the metal run into sand or chill castings should be ascertained. The brinell test bar, Fig. 5, is in practical use by a prominent firm that makes iron castings in permanent molds. By pouring pig iron containing steel scrap, directly from

Table I

Specifications for Scrap for Use in Blast Furnaces

Pipe Busheling Scrap

Iron and steel pipe and flues (clean, bedstead tubing and similar material cut 8 inches and under in length, free from galvanized material and foreign metals.

Cast Iron Borings

Clean cast iron borings free from badly corroded material, lumps, scale, other metals, dirt or foreign material of any kind.

Shoveling Turnings

Clean, short steel and wrought iron turnings, drillings or screw cuttings, free from stringy, bushy or tangled material, corroded or rusty lumps, excessive oil, scale, other metals, dirt or foreign material of any kind.

Alloy steel scrap may be excluded from the specifications by mutual agreement between buyer and seller.

Mixed Borings and Turnings

Clean, short, steel and wrought iron turnings, drillings, screw cuttings, and cast or malleable iron borings and drillings, free from stringy, bushy, tangled, corroded material, lumps, excessive oil, scale, other metals, dirt or foreign material of any kind.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

Corroded Borings and Turnings

Corroded and lumpy borings, turnings and similar stocks, free from scale, other metals, dirt or foreign material of any kind. No dimensions to exceed 9 inches.

Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

Burnt Iron Scrap

Old annealing boxes, stools and pots, grate bars and burnt iron. No dimensions to exceed 9 inches, except brake shoes, which may be included.

Mill Scale

Iron oxide produced in rolling mill practice, from drop forge hammers or from a busheling mill squeezer. Should contain not less than 65 per cent metallic iron and must be reasonably free from dirt, grease and other foreign material.

Scale from alloy steel may be excluded from these specifications by mutual agreement between buyer and seller.

Mill Cinder

Cinder from puddling, heating furnaces and soaking pits. Should contain not less than 50 per cent iron and be reasonably free from dirt and other foreign materials. Cinder from alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.

Table II

Hardness Tests

Fig.	Grade	Furnace	High	Low	Average
1	3	1	414.7	178.5	242.0
2	1	2	228.7	162.7	195.0
3	2X	3	301.9	105.9	178.7
4	1	4	387.7	178.5	227.2

the blast furnace, into a mold of this kind and then remelting in the cupola or electric furnace and pouring similar test bars, valuable data should be obtained on the influence of remelting on hard spots.

The bureau of standards examined the sample shown in Fig. 4 and commented on its results as follows:

"Noted present in the microstructure as developed by either alcoholic picric acid or 2 per cent nitric acid solution were two types of small hard particles as seen under a magnification of about 300 diameters.

"Irregular-shaped and standing out in marked relief—these are assumed to be free cementite (Fe_3C) and the quantity present appears to be small and quite as expected from the amount of combined carbon reported in the pig iron analysis; and

"Angular-shaped, mostly cubical and sometimes triangular, particles distributed rather indiscriminately throughout the matrix, though oftentimes along side and close to the edge of a graphite flake cavity—These particles are assumed to be a titanium compound as nitride or cyanonitride of titanium or possibly titanium carbide.

"One would not be justified, by the lack of information on the conditions surrounding the manufacture of the pig iron in question, in advancing an opinion for explanation of the formation of the hard spots in the pig iron. The writer was unable to find any reference in the literature to the specific effect, if any, produced by titanium upon the transformation range of iron-carbon alloys. It would seem, however, from the results reported previously that titanium has a tendency to lower the transformation range and that the upper surface of the pig iron represented by the specimens on hand was cooled more rapidly than the interior portion, thus producing a different microstructure, as well as a slight increase in hardness."

It is evident that the mechanism of the brinell hardness of cast iron may be expected to offer considerable difficulty when steel scrap or alloy scrap is added to the blast furnace burden.

An increasing tendency of large castings to crack and difficulties in machining may be expected as one of the consequences of the lack of uniformity of pig iron made by adding scrap to the blast furnace. In this connection it may be noted that an increasing number of foundries in the United States are annealing their gray iron castings. Some anneal at 1100 degrees Fahr. to remove internal stresses only, while others anneal at a somewhat higher temperature and for a longer period not only to remove internal stresses, but also to increase machinability without materially reducing the tensile strength of the castings.

The use of forehearths or large mixing ladles in connection with cupola melting, or better yet, electric furnace melting, should give a more uniform product even if a heterogeneous material must be charged.

Pig-iron makers are interested just as vitally in learning the effect of scrap additions to the blast furnace on the quality of the pig iron produced by them as are the users of the material. Two blast furnaces in the Chicago district of the United States already have expressed a willingness to co-operate with the sub-committee on pig iron of the committee on gray iron castings of the American Foundrymen's association. It is proposed to make several runs of all-ore pig iron and on pig iron containing known amounts of scrap.

Practical tests by various foundries on the pig iron, with physical tests and analytical tests especially for oxygen, it is hoped will enable a mutual and better understanding to be reached by the foundry and blast furnace interests as to the effect on the quality of pig iron of the addition of iron and steel scrap to the blast furnace. It is realized that considerable data must be collected that it may be convincing and that many variables in blast furnace and foundry practice must be eliminated.

Table III

Analyses of Irons Tested

CONSTITUENT	GRADE 3	1	2X	1
Total carbon	4.09	3.79	3.96	3.81
Graphitic carbon	3.46	3.39	3.02	2.93
Combined carbon	0.63	0.40	0.94	0.89
Manganese	0.68	0.69	0.75	0.63
Phosphorus	0.454	0.504	0.565	0.573
Sulphur	0.031	0.021	0.023	0.012
Silicon	1.23	2.36	2.18	3.07
Chromium	nil	nil	0.08	0.05
Vanadium	nil	nil	trace	trace
Nickel	nil	nil	nil	nil
Titanium	0.11	0.13	0.24	0.36

Introduces Core Oils

Pennsylvania Lubricating Co., Pittsburgh, subsidiary of the Standard Oil Co. of New Jersey, has introduced a new line of core oils under its own trade name. G. R. Meyers, who for a number of years was connected with one of the largest core oil manufacturers, has been appointed manager of this new department and has assumed active charge.

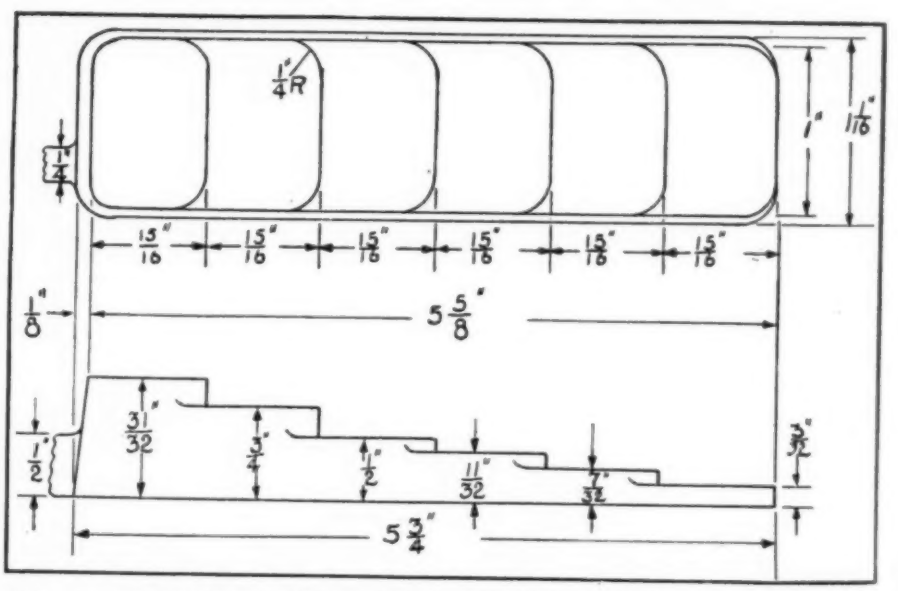


FIG. 5—STEP TYPE TEST BAR USED FOR DETERMINING HARDNESS OF PERMANENT MOLD CASTINGS

MILESTONES

in Foundry Progress

As Recorded in the January Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

MULTIPLE molding was attracting considerable attention even in this latter day of the gay nineties. The lead story in THE FOUNDRY of January, 1898, describes a machine for making plow points. The machine rammed the molds on edge, the cope impression appearing on one side and the drag on the other. These molds then were set on edge and closely held while being poured. The machine itself operated by toggle levers with two cross heads, the operating principle resembling that of the hay press. Two tanks of water were gas heated and circulating water was supplied to keep the patterns warm.

* * *

The suggestion that the addition of two to five pounds of aluminum be added to each ton of molten iron with highly beneficial results was questioned. Apparently the high cost of aluminum served to deter active participation in this form of metal doctoring.

* * *

RUTHLESS RHYMES

Gold, silver or platinum rare,
Two pounds each, either gross or tare,
Added to a ton of cupola metal,
Bring no more cash, when customers settle.
A. V.

* * *

A wit, writing under the suggestive name of A. Hornswoggler (a nifty of the nineties for one who befools the public) describes a cupola of rare interest, said to melt at a ratio of 1 to 34. The escaping gases were repassed, with the addition of oxygen and steam, the latter being intended to keep the combined carbon soft on the same principle that steam softens glue on a postage stamp.

* * *

Inspiration could be secured and imagination kept highly lubricated in those days without recourse to the hip or the highjacker.

* * *

The man who bewails low prices generally had a hand in making them.
KRANK'S KORNER

* * *

Western Foundrymen's association, meeting in Chicago, considered a paper on costs by W. N. Moore and another on sand by D. H. Truesdale. Individual rather than group costs were favored in the discussion.

* * *

The Glamorgan Pipe & Foundry Co., Lynchburg, Va. was erecting a new foundry.

EXCEPTIONALLY fine ornamental bronze castings with a description of the plant in which they were made, the Henry Bonnard Bronze Co., Mt. Vernon, N. Y. formed the subject matter of the leading article in THE FOUNDRY for January, 1908. Many of the bronzes shown were for the state capitol at Harrisburg, Pa., then under construction.

* * *

W. W. McCarter described in detail the method of molding a large bed plate for a pulverizer. Mr. McCarter at present is in charge of the foundry of the Agricultural & Mechanical college, College Station, Tex.

* * *

The Associated Foundry Foremen of Chicago was arranging an exhibit of foundry equipment to be held at the Lewis institute, Chicago, under direction of C. E. Hoyt, then connected with that educational institution.

* * *

Exhibits soon became a habit with that same C. E. Hoyt, now secretary of the American Foundrymen's association. He still is arranging exhibitions—and HOW!

* * *

W. A. Bole presented a paper on the relation of the foundry to the department of engineering design for the American Society of Mechanical Engineers which was abstracted in the January issue of THE FOUNDRY, 1908.

* * *

The report of the cost committee of the Jobbing Founder's association was presented by J. L. Sterling, foundry manager, Hilles & Jones Co., Wilmington, Del.

Thus showing that a jobbing foundrymen's association and group cost systems are by no means new ideas in this day of enlightenment, 1928.

* * *

Northern foundry No. 2 iron was selling for $17.50 to $18.00 a ton, while southern grades were offered at $14, Birmingham. Foundry business was slack.

* * *

The Walworth Run Foundry Co. was building a new foundry at W. 27th street, Cleveland.

* * *

J. F. Buchanan was writing a series of discussions on jobbing brass foundry practice. These articles later were assembled and formed a basis of a splendid book on the technical details of brass founding.

CASTING large guns of iron in the early eighties was described in detail in the January, 1918, issue of THE FOUNDRY. The author of this article, Job Goostray, recently has completed 65 years active service in the foundry industry.

* * *

The use of cores to cut molding costs, as exemplified at the plant of the Missouri Malleable Iron Co., E. St. Louis, Ill., was presented in a leading article.

* * *

Conservation of coke supplies, as a war measure to relieve the railroads, was suggested editorially.

* * *

The heatless, eatless, gasless days of the World War were approaching.

* * *

James Lanigan was appointed superintendent of the Portage Foundry Co., Akron, O., Mr. Lanigan now is superintendent of the Valley Mould & Iron Corp., Sharpsville, Pa.

* * *

Foundry construction was going ahead rapidly in the face of increasing war demands.

* * *

A. H. Jameson was made vice president and general manager, Bayonne Steel Casting Co., Bayonne, N. J.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Sand Is a Puzzle

AFTER investigating the subject of sand diligently and patiently for a period of several years, the general committee and various subcommittees appointed by the American Foundrymen's association find that an almost limitless amount of work still remains before a final report can be submitted. Every angle attacked on the supposition that it represented a single phase has disclosed a bewildering maze of divisions and sub-divisions. Just before an investigator concludes a series of experiments that promise the establishment of a definite standard, he discovers several additional factors that either nullify former conclusions or involve an entirely new set of experiments. The work is slow and tedious and the association is to be congratulated for numbering men in its ranks who are willing to devote so much time, thought and energy to such a slippery problem.

CREDIT in generous measure also is due various foundry owners, prominent sand producers and others who bear the expense of these investigations. To a certain extent they stand to benefit. The knowledge gained may be applied directly to the problems of the individual foundries and the sand companies can meet the requirements of their customers in a more intelligent and satisfactory manner. However, the interesting feature of the situation and the one on which the American Foundrymen's association particularly is to be congratulated is that the results of the investigations are not held tightly, but are presented for dissemination to the foundry industry at large. The work also has been greatly facilitated by a generous fund donated by prominent manufacturers of foundry equipment at the Columbus convention.

WHILE the work is by no means finished, great progress has been made. Not the least of the results is the widespread interest that has been aroused and the raising of the general standard of knowledge among foundrymen on this important subject. Tentative standards have been put forward and ingenious apparatus has been developed for testing sand according to grain size, bond and permeability. The main problem still remaining is to correlate these tests so that they may become interchangeable.

¶ Routine Smothers Leadership

RECENTLY, while speaking of the trend of modern civilization toward overorganization, Dr. Glenn Frank, president of the University of Wisconsin, deplored the attitude of the general public which permits drafting great political, religious and educational leaders into executive positions, only to see them chained to desk duties.

Such criticism undoubtedly is timely. The American public apparently believes that the only fitting and proper way to reward leadership in lines of public relationship is through public office. Usually the many small details associated with the office, which probably could be handled just as satisfactorily by one less gifted, require so much time that the bigger services for mankind must be neglected.

HOWEVER, the list of abused leaders does not end with the three groups already named. In technical societies, the membership seems only too willing to pile every little task upon the individual who has shown the sparkle of the gem of leadership. Little regard is shown for his time. Probably he is forced to neglect his own business to play the part of the good fellow and serve the multitude. An effort is made to bring the world in general to believe that an honor is conferred upon the recipient of the job, when in reality this may prevent him from being of greater benefit to the organization.

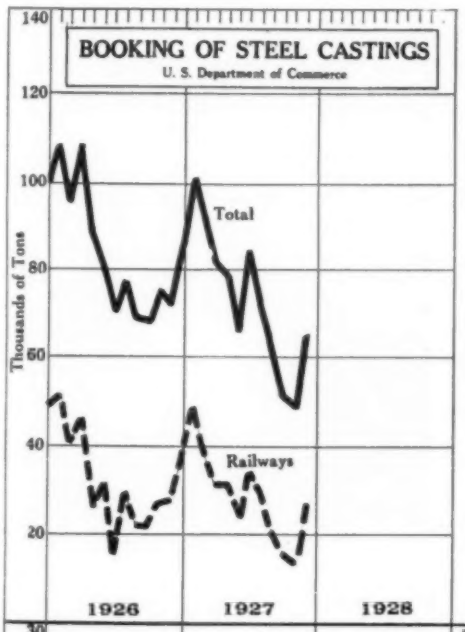
When every member wakes to the fact that he can get only as much out of an organization as he puts in; when organizations stop giving all the work to a few members who have indicated by past performance that they have the capacity and willingness to carry on the additional duties; when the work is passed around and each member expresses a willingness to carry a share of the activities, the usefulness of an organization will develop beyond its greatest expectations.

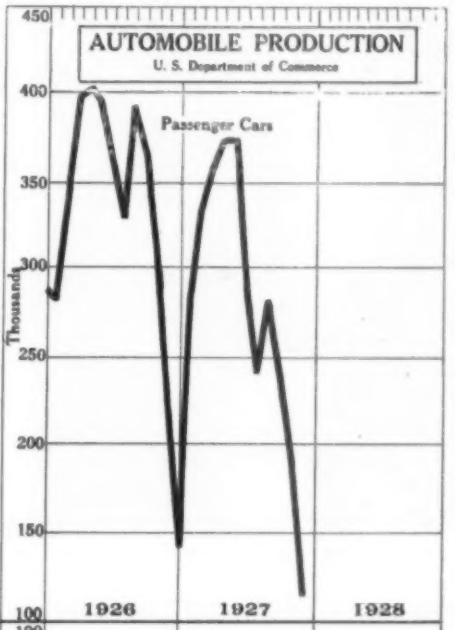
Trade Trends in Tabloid

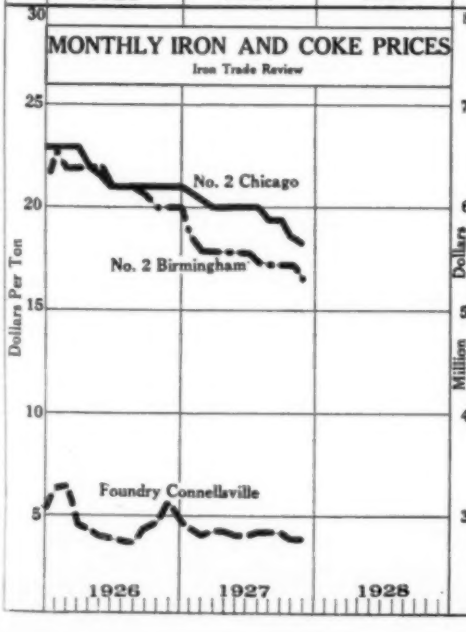
WITH the turn of the year, brighter prospects are reported in the entire foundry industry. The period just passed has been described as one of waiting rather than actual stagnation or depression. This appraisal of general business conditions is taken to apply equally in the castings manufacturing branch of industry. Buying has been at a peak during the holiday period according to reports from retail and mail order sources. With more than 10,000 railway cars in inquiry or in active contemplation, the long deferred buying from railroads is expected to develop early in the year. The low point in automobile production has passed with few casualties and an upturn is at hand. Shortages have developed in fundamental commodities, such as iron and steel products, due to the descending scale of operations during the last half of 1927. Definite signs of increased demand are at hand. Building construction in 1927 was below that of the preceding year, and the availability of credit at low rates is expected to stimulate this line of business during 1928. Purchases of iron by the large pipe and radiator shops and other specialty foundry interests indicate better expectations for the first half of the present year. Nonferrous foundry operations which experienced a sharp decline in November and December are expected to improve since stocks are low.

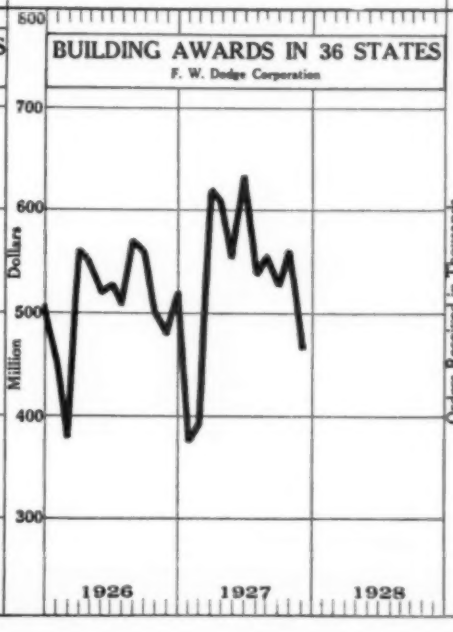
RAW MATERIAL PRICES
Dec. 22, 1927

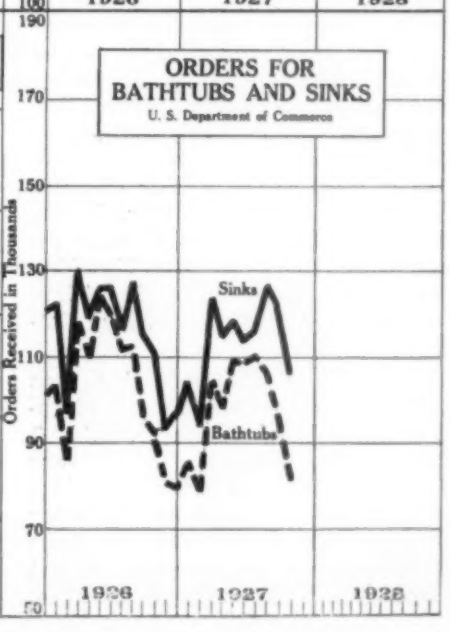
Iron	
No. 2 foundry, Valley	$17.25 to 17.50
No. 2 southern, Birmingham	16.00
No. 2 foundry, Chicago	18.50
No. 2 foundry, Philadelphia	19.76 to 20.26
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	18.50
Malleable, Buffalo	17.50
Coke	
Connellsville foundry coke	$3.50 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$14.75 to 15.00
Heavy melting steel, Pitts	15.25 to 16.00
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Chicago	12.00 to 12.50
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	14.00 to 14.50
No. 1 cast, Buffalo	11.50 to 12.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	12.50 to 13.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	14.50 to 15.00
Railroad malleable, Pitts	14.50 to 15.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.75 to 13.87½
Electro copper, producers	14.00 to 14.12½
Straits tin	58.37½
Lead, New York	6.50
Antimony, New York	11.12½
Nickel, electro	39.00
Aluminum, No. 12, producers	23.50
Aluminum, No. 12, remelt	17.00 to 18.00
Zinc, East St. Louis, Ill	5.65











Comings and Goings of Foundrymen

RICHARD G. PARK JR., whose election to the vice presidency of the Eagan-Johnson Steel Co., Crum Lynne, Pa., was noted in the Dec. 15 issue of THE FOUNDRY, formerly was treasurer of the Ford Chain Block & Mfg. Co., Philadelphia. Besides being vice president of the Eagan-Johnson company, he is secretary of the Hutchinson Mfg. Co. Inc., Norristown, Pa., and a director of the Chester County Trust Co., West Chester, Pa.

Morton Grindal, Bergen, Norway,

RICHARD G. PARK JR.

manager of a malleable foundry, who attended the American Foundrymen's convention in Detroit in 1926 as the official delegate for the Norwegian Foundrymen's association, recently has engaged in foundry equipment manufacturing.

H. S. Lord, for a number of years vice president and treasurer, Moline Plow Co., Moline, Ill., and more recently with the J. L. Case Threshing Machine Co., Racine, Wis., has joined the Nichols & Shepard Co., Inc., Battle Creek, Mich.

Eugene A. Balsley, who has been made vice president in charge of operations of the Wheeling Mold & Foundry Co., Wheeling, W. Va., was at one time with the American Bridge Co., serving as assistant operating manager and manager of the forge department in the Chicago district for six years. He resigned from that company to engage in private consulting practice in Chicago and more recently was works manager of the Van Dorn Iron Works, Cleveland.

W. Homer Hartz has been elected vice president and manager of sales of the Modern Frog & Casting Works, Chicago, succeeding the late Arthur C. Smith.

Lewis N. Murray, general manager of the Dunkirk, N. Y. plant, National Radiator Corp., has resigned. Before becoming manager of this plant, Mr. Murray had been secretary and treasurer of the Continental Heater Corp.

Van Cortright Mekeel has been appointed special representative for the Nugent Steel Castings Co., Chicago. Mr. Mekeel formerly was connected with Taylor-Wharton Iron & Steel Co., High Bridge, N. J., as research investigator, mechanical and sales engineer.

James H. Slawson, president of the Chicago Malleable Castings Co., Chicago, has resigned to become president and general manager of the Western Malleables Inc., a new corporation which succeeds the Western Malleables Co., Beaver Dam, Wis.

Walter Troop, sales manager for North & Judd., New Britain, Conn., has resigned to become vice president of the O. B. North Co., Inc., New Haven, Conn.

H. C. Hoover, formerly general foreman, No. 1 foundry, Hubbard Steel Foundry Co., East Chicago, Ind., now is foundry superintendent with the Ohio Steel Foundry Co., Lima, O. Mr. Hoover was foreman at the Ohio Steel company in 1915, and in 1923 became foreman for the American Locomotive Works, Chester, Pa. He then became general foundry foreman for the Hubbard company which position he held for the past four years.

Otis Morgan again is in charge of the annealing department of the Terre Haute Malleable & Mfg. Co., Terre Haute, Ind. Mr. Morgan served in this same capacity 12 years ago.

Watch Old 348

Andy Gump wanted No. 348 for his automobile license this year.

At first inclined to be skeptical, the official funny-bone was tickled when the Michigan license bureau found that the applicant was E. Andrew Gump, purchasing agent for the Wilson Foundry & Machine Co., Pontiac, Mich.

Mr. Gump received his number.

Resigns Position

Ralph H. Bourne, senior vice president and director of the Whiting Corp., Harvey, Ill., has resigned after 20 years' service. He also has resigned as president of the Grindle

RALPH H. BOURNE

Fuel Equipment Co., and as vice president of the Joseph Harrington Co., both subsidiaries of the Whiting Corp. Mr. Bourne was graduated from the department of mechanical engineering, Cornell university, Ithaca, N. Y., and entered the employ of the Wellman-Seaver-Morgan Co., Cleveland, in 1905. Following this he was with the Hoover & Mason Co., Chicago. In 1907 he became associated with the Whiting company. Mr. Bourne is a member of the American Society of Mechanical Engineers.

Hear Talk on Coreroom

The Philadelphia Foundrymen's association held a meeting at the Manufacturers club in that city on Dec. 14. Prof. H. L. Campbell, University of Michigan, Ann Arbor, Mich., gave an illustrated talk on a study of coreroom problems.

Is Capacity Excessive?

(*Concluded from Page* 31)

straight line in Fig. 2. This has occurred in spite of the increase in consumption of steel castings shown in Fig. 1. In 1920 the demand for steel castings was close to 70 per cent of the capacity of the steel casting industry, and while the trend of consumption of steel castings has increased 16 per cent since 1920, the capacity of the industry has grown to such an extent that in 1927 the demand was reduced to less than 60 per cent of capacity. This means that between 1920 and 1927 steel castings consumption increased 16 per cent, yet the percentage of the capacity used for this increased consumption decreased from 70 per cent to less than 60 per cent. During the latter part of 1927, considerably less than 50 per cent of the capacity of the steel casting industry was utilized to meet the demand.

It is to be expected that the use of steel castings will continue to increase and perhaps at a greater rate than the rate of increase in population. However, it appears that in the public interest further expansion in the facilities for manufacturing steel castings should be delayed until a greater percentage of the present capacity of the steel foundries can be utilized to meet consumers' needs.

Family Album To Be Permanent Feature

THE FOUNDRY, *Family Photograph Album was instituted during the past year with a twofold purpose, as was outlined in an editorial in the issue of June* 15, 1927. *This purpose is to pay a tribute of respectful appreciation to outstanding men in the industry and to acquaint the world-wide circle of readers of* THE FOUNDRY *with the appearance and personality of these men. The second phase of this undertaking has proved so popular that a wish has been expressed that the portraits might be presented in suitable form for permanent preservation. Those making this suggestion have in mind an ever-growing collection of portraits of foundry notables, suitable for filing and reference.*

Accordingly, starting with this issue, the Family Album will appear on special coated stock, of excellent quality to present the portraits and make them available for filing. The Data Sheet, a feature of THE FOUNDRY *for more than twenty years, will be printed on the reverse side of this Family Photograph Album.*

THE EDITORS.

Book Review

Ancient Egyptian Metallurgy, by Major H. Garland and C. O. Bannister, 214 pages, cloth, 5½ x 8 inches, published by Charles Griffin & Co., Ltd., London and in America by J. D. Lippincott Co., Philadelphia and furnished by THE FOUNDRY, Penton building, Cleveland, for $5 and by the Penton Publishing Co., Ltd., Caxton House, Westminster, London, S.W.I. for 25s.

Delving into the secrets of the ancients as revealed by remaining relics of the metalworking art, the authors have traced not only the metallurgical knowledge, but a fair amount of the knowledge of actual craftsmanship of the early Egyptians. The sources from which the ancient kings obtained their metals are shrewdly searched out from the analyses of various museum pieces which were studied. The history of Egypt's metal manufacture also is revealed by this investigation. Nonferrous metals predominate in the specimens cited, but an early knowledge of iron, dating far ahead of that commonly designated as the beginning of the age of iron, is supported by many facts introduced by the authors. A metallographic study of the ancient metal work and a series of valuable notes on the cleaning and preservation of relics, added for the benefit of collectors of antique metal objects, conclude this interesting book.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings on third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, HENRY S. CHAFFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill.; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Washington Foundrymen's Club
Seattle

President, RONALD KUCHER, Olympic Foundry Co., Argo Station, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks' Temple, Fourth avenue and Spring street.

Industrial Leader Dies

Joseph Green Butler Jr., president of the Portage Silica Sand Co., Youngstown and director of the Youngstown Sheet & Tube Co. and numerous financial and industrial units of Northern Ohio, died at his home in Youngstown Dec. 20, just one day before his 87th birthday.

While known primarily as a leader in the iron and steel industry where he was active not only in the manufacturing and commercial phases, but also in the various associations which forwarded the interests of this great industry, Mr. Butler was known for his wide range of interests. He excelled as a business man, writer of books, and counselor in the affairs of social and public life. He was noted for his practical philanthropies, his devotion to art and participation in patriotic affairs.

Mr. Butler was born at Temperance Furnace, Mercer county, Pennsylvania, Dec. 21, 1840, the son of Joseph Green and Temperance Orwig Butler, and he spent his early years on a farm. When a small boy he went with his parents to Niles, where he received his early education in the public school. Later he was graduated from Duff's college, Pittsburgh. After leaving college, Mr. Butler began his career as a bookkeeper for James Ward & Co., Niles. In 1858 he was named financial manager of the concern, a position he held until 1863 when he took the district agency for Hale & Ayers, Chicago. In 1866, Mr. Butler was active in the project which brought into existence the Girard Iron Co. of which he was manager until 1878 when the company was absorbed by the Brier Hill Iron & Coal Co., to which Mr. Butler went as manager.

In 1912 when the iron and coal company became the Brier Hill Steel Co., Mr. Butler was elected vice president and remained in this office until 1917 when press of other duties compelled him to retire. In 1896, while still manager of the Brier Hill Iron & Coal Co., Mr. Butler was elected vice president of the Ohio Steel Co., which position he held until 1906.

He became a member of the American industrial commission to France in 1916, and also served on the council of national defense during the war. In the world war, many in America were startled by the publication of what was known as the Thyssen pamphlets, revealing Germany's duplicity. It was announced from New York that Mr. Butler had made it public. Thyssen, holding a similar position in the steel industry of Germany, had acquainted Mr. Butler with the facts relating to this matter.

In 1900 Mr. Butler was a delegate from Youngstown to the Republican national convention which nominated his friend William McKinley, for president and Theodore Roosevelt for vice president. Mr. Butler also was a delegate to the Republican national convention at Chicago in 1916.

Mr. Butler married Miss Harriet Voorhees Ingersoll at Homesdale, Pa., Jan. 10, 1866, who died in 1921. His son, Henry A. Butler, of the Youngstown Sheet & Tube Co. and a daughter Mrs. T. Arthur McGraw, of Detroit survive. Another daughter, who was the wife of the late E. L. Ford, died some years ago.

JOSEPH G. BUTLER JR.

D. P. Carter Is Dead

Donald Pershing Carter, New York district manager for W. W. Sly Mfg. Co., Cleveland, died recently in that city. Mr. Carter was graduated from the department of mechanical engineering, Cornell university, Ithaca, N. Y., in 1904. He entered the employ of the B. F. Sturtevant Co. in 1909 and remained with this firm until 1917.

During the period of 1917 to 1919 he was a captain in the chemical war service division and was engaged in engineering work at Edgewood arsenal, Baltimore. Mr. Carter then became sales engineer for the Massachusetts Blower Co., Baltimore and from 1920 to 1921 was heating and ventilating engineer, Foundation Co., New York. Since 1921 he had been in charge of the New York office of the W. W. Sly company. Mr. Carter is survived by his widow and one child who reside at Montclair, N. J.

Will Organize Club

Foundrymen of St. Louis and vicinity held a dinner meeting at the rooms of the Missouri Athletic association on Dec. 6, 1927, to discuss the organization of a club whose members will include foundrymen and those in allied lines. Early in January another meeting will be held at which time action will be taken on the by-laws and the officers will be elected. About 40 prospective members were present and Leo. J. Filstead, John C. Kupferle Foundry Co., St. Louis, acted as temporary secretary.

Is Made President

W. R. Bean, vice president and consulting engineer, Grindle Fuel Equipment Co., Harvey, Ill., since August, has been made president succeeding R. H. Bourne who resigned recently. Mr. Bean has been in the malleable foundry field for 25 years, having entered this work after graduation from Virginia Polytechnical institute. Mr. Bean went to the Grindle company from the Eastern Malleable Iron Co., Naugatuck, Conn.

Speaks on Alloy Iron

The December meeting of the Quad-City Foundrymen's association was held in the LeClaire hotel, Moline, Ill., on Dec. 19, 1927. D. M. Houston, foundry engineer, International Nickel Co., New York spoke on the use of alloys to improve the quality of cast iron.

Meet in New England

The New England Foundrymen's association held a meeting at Boston on Dec. 14. Dr. Richard Moldenke, Watchung, N. J., addressed the members on, "What Quality Pig Iron." A nominating committee to propose officers for 1928 was appointed.

Corrects List

E. S. Clark is secretary; C. W. Brown, treasurer and assistant secretary, and A. J. Copeland is assistant treasurer of the Industrial Brownhoist Corp., Cleveland, according to a verified report. The other officers are as stated on page 945 in the Dec. 1, 1927 issue of THE FOUNDRY.

E. J. Lavino & Co., Philadelphia-Pittsburgh-Chicago, has taken over the sale of brick made by the Big Savage Fire Brick Co., Frostburg, Md. In addition to fire clay brick, they will specialize in the distribution of its roof brick for heating furnaces, cupolas, etc.

Daily Melt of Auto Shop Is 700 Tons

(*Concluded from Page* 12)

sary, ramming the sand, rolling or otherwise placing the core on a plate and removing the corebox. His sand, wires, dryers and plates are brought to him and his cores are carried away and placed on the racks by other men. A special crew unloads the dried cores after they emerge from the oven, while other operators in turn, dip, paste, blackwash, assemble, check, gage and push the cores along on roller conveyors to a battery of vertical ovens where the assembled cores are re-dried before they are placed on the conveyor which carries them to the stations.

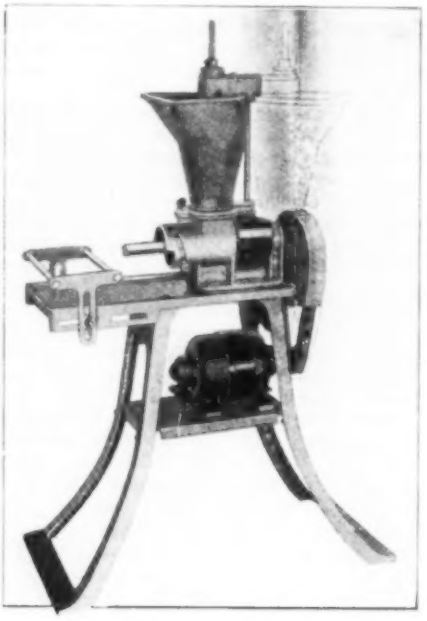
Plain, cylindrical barrel cores are made in an extrusion type machine the product of the Wadsworth Core Machine & Equipment Co., Akron, O. The machine is equipped with a mechanical bucket feed, a foot lever and clutch control and a wire for cutting the cores to the right length. Two men attend the machine. One operates the feed mechanism and the other removes the cores and places them on a rack. Each machine produces 5000 cores in a 9-hour day. Machining tolerances are held to close limits in the cylinder bores, therefore these cores must be made and dried with the greatest accuracy. To prevent a flat spot, each core is dried in a shell instead of on a plate.

Roller conveyors similar to those shown in Figs. 1 and 6 and placed in this and other parts of the plant by the Matthews Conveyor Co., Ellwood City, Pa., are utilized to convey the cores from the ovens to the various stations where the assembling process is conducted progressively.

Cores for cylinders and cylinder heads are not placed individually in the molds. The entire set of cores is fitted, pasted and wired together in the core assembling department and then placed for approximately 2 hours in an elevator oven where the paste and blacking are dried thoroughly. The discharge side of one of these double ovens is shown in Fig. 13, with two attendants removing assembled head cores and placing them on a roller conveyor leading to one of the three main conveyors serving the molding stations. Each oven in effect is an enclosed vertical conveyor equipped with swinging shelves. It is heated with gas and geared to make a complete revolution in 2 hours. Cores are entered on one side of the oven where the shelves are traveling upward and removed on the opposite side as they descend. Nine double ovens and two single ovens have been installed.

Makes Changes in Design of Core Machine

The American Foundry Equipment Co., Mishawaka, Ind., recently has made a number of changes in its extrusion type core machine. This machine first was introduced in 1905 by the Brown Specialty Machinery Co., Chicago, and has been marketed by the American Foundry Equipment Co. since 1919. The machine, which is shown in the accompanying illustration, is equipped with a force feed rod and mixer to insure uniform sand for all sizes of cores. A specially



AN AUXILIARY HOPPER MAY BE USED WHEN DESIRED

designed hopper makes it possible to use an auxiliary hopper when desired. The hopper has been especially designed to prevent the sand from bridging or collecting in pockets.

The hopper may be swung to one side to gain access to the conveying chamber. An adjustable, tubular, die holder is provided to allow rapid and easy adjustment of the tube length. It is claimed that the tubes wear longer, due to this special method for regulating the density of the sand. The machine may be supplied either for a direct motor drive as shown in the illustration, or to be driven from power shafting. While the machine is designed for a power drive, it may be supplied for hand operation where necessary. The machine is bolted to a heavy cast base.

Nine conveyors will produce cores ranging in diameter from ⅜-inch to 3 inches. The screw also has been redesigned to give larger vent holes in the cores. Screws are made of special hardened steel. The company also manufactures a cutting off and tapering machine for sizing and coning cores.

Steps Up Production

(*Concluded from Page* 17)

pleted. The general scheme of the pattern department is shown in Fig. 11. Several of these tables with complete pattern equipment usually are lined up in the desired order near the molding station. After the required number of cope and drag molds have been made from one pattern, the plates are removed from the machines and replaced by new plates taken from the tables.

Teamwork and co-operation have been developed to a remarkable degree throughout the foundry. With the moving conveyors setting the pace, all other interlocking operations in the plant function like clockwork. Before the installation of the new equipment, an average production of the plant was 70 molds a day for each pair of machines. The installation of the conveyors and the other changes made in the recent revamping of the plant have brought the average production to 105 molds a day, and further increases are expected soon.

The plant manager receives a report of the work done the previous day on his desk each morning. One of these reports is reproduced in Fig. 12. This sample was selected at random and represents about the average. It shows that out of 1495 castings made, 55, or less than 4 per cent, were reported bad. However, after the number of defects due to poor workmanship in applying the abrasive material, is deducted, rejects equal about 2½ per cent. The latter percentage should be used for comparison with other gray iron foundries which do not use abrasive materials. Records show a daily loss at times of less than 2 per cent.

The power mold conveyors and the entire sand handling and preparing system, including the jolt cylinders used at the shakeout, were designed and manufactured by the Osborn Mfg. Co., Cleveland. The electric overhead cranes were built by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., while the pneumatic hoists were supplied by the Curtis Pneumatic Machinery Co., St. Louis. The sandblast equipment was built by the Pangborn Corp., Hagerstown, Md., and the air hammers for the straightening machines were supplied by the Chicago Pneumatic Tool Co., New York.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Madden Iron Works, Los Angeles, Calif., recently installed some new molding machines.

Winona Machine & Foundry Co., Winona, Minn., had its foundry building damaged by a fire recently.

Superior Steel Castings Co., Benton Harbor, Mich., recently suffered a slight damage by fire.

Gibson Bros. Mfg. Co., North Chicago, Ill. is adding a line of new type water faucets to its production.

Liberty Brass Foundry, 24 Thomas street, Bloomfield, N. J., plans to build a 1-story foundry addition 35 x 85 feet.

Rockford Metal Specialty Co., Rockford, Ill., maker of automobile hardware, contemplates building a 3-story addition.

Buda Co., Harvey, Ill., maker of railroad appliances, will build a 3 and 4-story addition.

Gluntz Brass Mfg. Co., 3001 East Fifty-fifth street, Cleveland, was slightly damaged by an explosion in the plant.

A. J. Hall, 413 Highland avenue, New Castle, Pa., contemplates building an ornamental iron and bronze plant here.

Divekey Foundry & Machine Co., Aurora, Ill., operating for several years, has just built a brass foundry to manufacture castings, continuing also, its iron foundry.

LaSalle Brass & Bronze Works, Brooklyn, N. Y., has been incorporated with $10,000 capital by W. Sparago, 26 Court street, attorney.

Humphrey Mfg. Co., Mansfield, O., has awarded the contract for a 1-story foundry building 50 x 120 feet and a cleaning room 30 x 120 feet.

Master Electric Co., Master avenue, Dayton, O., will build a 1-story foundry and has awarded the contract to the Dayton Structural Steel Co.

Davenport Machine & Foundry Co., Davenport, Iowa, recently was reincorporated under the laws of Illinois. The firm is capitalized for $34,238.

Belmore Co., Durham, N. C., has been incorporated with $50,000 capital to manufacture heaters, furnaces, etc., by J. B. Moore, 712 Boylan drive, Raleigh, N. C.

Automatic Safety Valve Co., Lynn, Mass., has been incorporated with $10,000 capital to manufacture valves, by Ernest W. Williams, 33 Sweetser terrace, Lynn.

Akron Full-Circle Mold & Equipment Co., Akron, O., has been incorporated with 240 shares no par value by W. J. Bowes, L. H. Hall and C. Blake McDowell.

Heebner & Sons Inc., Lansdale, Pa., agricultural implement manufacturer, has added to its list of products, doughnut making machines. (Noted Dec. 15)

Stoody Co., Azusa, Calif., manufacturer of drilling tools and materials for the oil industry, has awarded the general contract for a new plant to the Union Iron Co.

New Oxford Foundry & Mfg. Co., New Oxford, Pa., Lynn Grove manager, has leased for two years, the former F. L. Weaver foundry, to take care of increasing business.

Segal Lock & Hardware Co., 155 Leonard street, New York, has awarded the contract for a 1-story foundry building, to B. Robertson, 101 West Forty-first street, New York.

Longview Foundry, Longview, Wash., W. M. Reilein, manager, equipped to manufacture gray iron, semi-steel, bronze and aluminum castings, has started operations.

Jones, Fox & Co., has been organized by Thomas W. Jones, Ellwood City, Pa., to conduct and operate a foundry, pattern manufacturing shop and machine works.

Structural steel for the plant of the Massilon Steel Castings Co., Massilon, O., has been awarded to the Massilon Bridge & Structural Co.

Johnson Bronze Co., New Castle, Pa., will build a structure for machine shop purposes on its site on South Mill street. The building will house a press.

Craig Shipbuilding Co., Long Beach, Calif., will rebuild its foundry which was burned recently. Improvements to the municipal wharf will be made by the city.

W. D. Browning, Lyceum building, Memphis, Tenn., contemplates establishing a metal salvage plant, installing a steel foundry, gear cutting department and machine shop, etc.

Oakland Foundry & Machine Co., Rochester, Mich., recently broke ground for an addition 36 x 120 feet which when completed will give the firm 12,000 square feet of molding floor space.

Excelso Products Inc., New York, has been organized by the American Radiator Co. to acquire the assets of the Excelso Specialty Works Inc., Buffalo, maker of hot water heaters, phaeton heaters, etc.

Mosher Steel & Machinery Co., Dallas, Tex., has completed work on its office, structural steel and concrete bar fabricating plants, and will soon build its machine shop, blacksmith and ornamental shops, and foundry.

Plans for a merger of the Laib Co., Louisville, Ky., and the J. L. Mott Co., Trenton, N. J., recently were made known when the company sent letters to its stockholders asking approval.

Saginaw Products Co., Saginaw, Mich., has sold its gray iron foundry to the Chevrolet Motor Co., to be devoted to pouring castings for that company exclusively. New conveying equipment and other devices have been installed.

Wilhite Machine Works, manufacturer of lawn-sprinkler systems, water sprayers, valves, etc., will manufacture its product at Los Angeles, and contemplates building a new plant.

Service Bronze & Brass Works, Portland, Oreg., has been incorporated with $40,000 capital to engage in general foundry business by Earl Henderson, Peter De Pew and G. H. Lester.

Acme Pattern Works, West Allis, Wis., has removed into its new plant at Fifty-sixth and Greenfield avenues. J. F. Schnaufer is president and G. Hoffman secretary of the firm.

Ohio Pattern Works & Foundry Co., 2730 Spring Grove avenue, Cincinnati, has increased its capital and contemplates expansion, with an addition, 60 x 250 feet and a 5-story power house.

Creamery Package Mfg. Co., Chicago, has moved into its new office building and factory at 1243 West Washington boulevard. The firm has foundries at Lake Mills and Fort Atkinson, Wis., and Derby, Conn.

Fire damaged the Oregon City Foundry, Oregon City, Oreg., to the extent of $13,000 in equipment and $6,000 on patterns. The firm's present site has been sold to the Hawley Pulp & Paper Co. of that city and the Oregon City Foundry has purchased a new site a few blocks south. Plans are well underway for new buildings and the company expects to remove to the new location in the early spring. (Noted Dec. 15).

San Angelo Boiler & Welding Co., 228 South Oakes street, San Angelo, Tex., will build a warehouse 45 x 60 feet and enlarge its gray iron foundry by a 40 x 42-foot addition, to include a 42-inch cupola.

Scottdale Machine Foundry & Construction Co., Scottdale, Pa. recently has completed an addition 40 x 80 feet which now gives the firm 10,000 square feet of floor space. Edward Byrne is president and Carl Pritchard secretary and general manager.

Standard Brass Mfg. Co., Alex Noll, president, Thirteenth street and Chestnut avenue, Kansas City, Mo., is erecting a new plant 100 x 128 feet and will install additional equipment for manufacturing brass, bronze and aluminum castings.

American Mfg. Co., Weatherford, Tex., will remove its general offices to Fort Worth, Tex., early in 1928 when its new buildings are completed. The Weatherford plant will be maintained as a branch. The company manufactures oil field equipment.

Manufacturers' Brass Co., 2723 Poplar avenue, Chicago, has been incorporated with a capital of $25,000 to operate a foundry for casting and finishing metals, by Carl B. Aplon, Bryan Y. Craig and David Doinick. Bryan Y. Craig, 7 South Dearborn street is correspondent.

Western Malleables Inc., Beaver Dam, Wis., has been granted a charter and will succeed the Western Malleables Co., of that place which discontinued operations Oct. 15. James H. Slawson, formerly president of the Chicago Malleable Castings Co., Chicago, will be president and general manager of the new company.

Final settlement of the receivership of the Thacher Propeller & Foundry Co., Albany, N. Y., is set for Jan. 21 before the United States district court at Albany. Remaining property, including patents, will be sold at public auction at the time and final report of distribution of assets by the receiver will be made.

Morris Foundry, 20 East Sibley street, Fond du Lac, Wis., has been incorporated with $100,000 capital stock under the name of Morris Foundry Inc. The firm manufactures brass, bronze and aluminum castings and machined parts. No change in ownership or management will take place. Newton Morris is principal owner and president of the new corporation.

New Trade Publications

PULVERIZERS—Bethlehem Steel Co., Bethlehem, Pa., has issued a catalog of its pulverizers. It is a larger publication than previous issues devoted to this subject. Illustrations shows details of construction and operation. Diagrams and line drawings add further information.